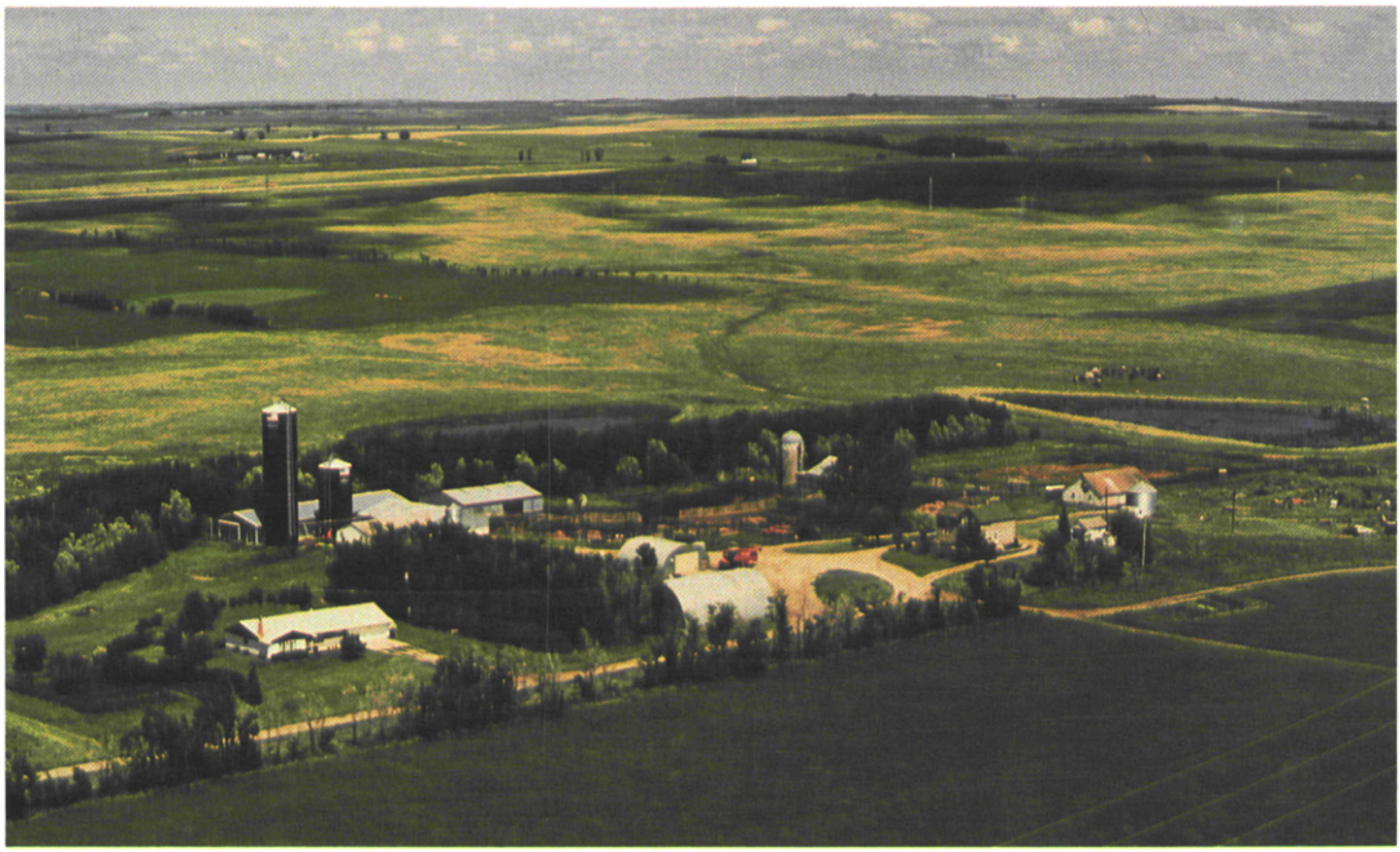
United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with U.S. Department of the Interior, Fish and Wildlife Service; North Dakota Agricultural Experiment Station; North Dakota Cooperative Extension Service; and North Dakota State Soil Conservation Committee

Soil Survey of Stutsman County, North Dakota



How To Use This Soil Survey

General Soil Map

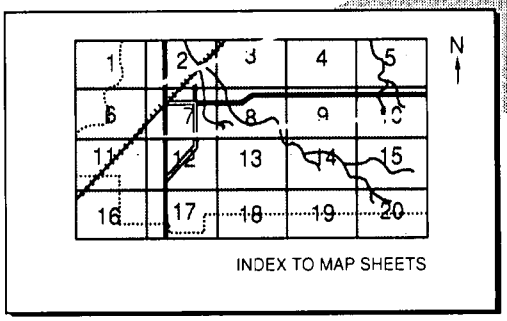
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

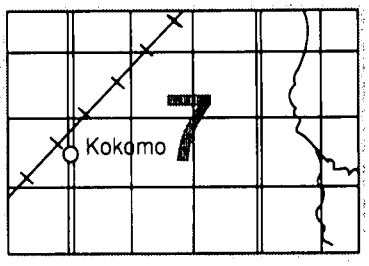
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

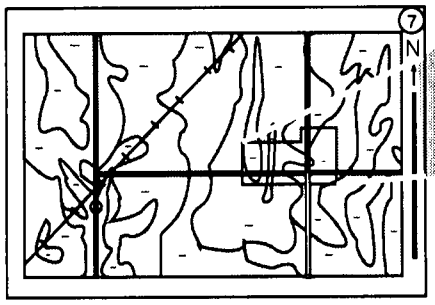


INDEX TO MAP SHEETS

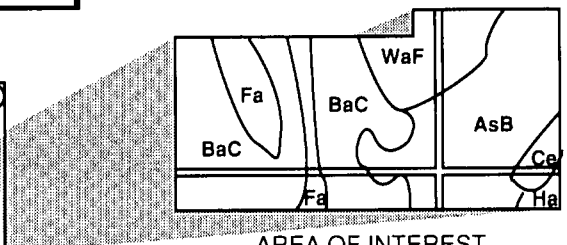


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1990. The flight for the photo base was in 1980. This survey was made cooperatively by the Natural Resources Conservation Service; the U.S. Department of the Interior, Fish and Wildlife Service; the North Dakota Agricultural Experiment Station; the North Dakota Cooperative Extension Service; and the North Dakota State Soil Conservation Committee. It is part of the technical assistance furnished to the Stutsman County Soil Conservation District. Financial assistance was provided by the Stutsman County Soil Conservation District, the North Dakota Department of University and School Lands, and the Stutsman County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of the Barnes-Buse association where a farmstead is protected by a windbreak. The Parnell soils are in the depressions. An area of Barnes and Svea soils is in the foreground.

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Issued June 1995

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Stutsman County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Ronnie L. Clark
State Conservationist
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Soil Survey of Stutsman County, North Dakota

By Patrick L. Abel, Alan Gulsvig, David L. Johnson, and James Seaholm, Natural Resources Conservation Service

Fieldwork by Ricky Bigler, Howard Campbell, Thomas DeWitt, Steve Ernst, Steven Fischer, Patrick Abel, David L. Johnson, Todd Soukup, Brenda Frazer, James Gertsma, Alan Gulsvig, Kenneth Liudahl, Karen Stevenson, and James Strum, Natural Resources Conservation Service; and Stoneman-Landers, Inc., Wilhelm Soil Consulting, Inc., Nordan J. Lunde, and David Wroblewski, professional soil classifiers

Map finishing by the North Dakota State Soil Conservation Committee and the Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
the U.S. Department of the Interior, Fish and Wildlife Service; the North Dakota Agricultural Experiment Station; the North Dakota Cooperative Extension Service; and the North Dakota State Soil Conservation Committee

STUTSMAN COUNTY is in the southeastern part of North Dakota (fig. 1). It has a total area of 1,470,400 acres, of which 1,443,320 acres is land and 22,000 acres is bodies of water more than 40 acres in size. Also, 5,080 acres is bodies of water less than 40 acres in size. The county is bounded on the south by La Moure and Logan Counties, on the east by Barnes and Griggs Counties, on the north by Foster and Wells Counties, and on the west by Kidder County. The county seat is Jamestown, which is in the east-central part of the county.

The county is in the Central Black Glaciated Plains portion of the Northern Great Plains Spring Wheat Region *(15)*. The eastern one-half of the county is in the Drift Plains district of the Central Lowland province, and the western one-half is in the Missouri Coteau district of the Great Plains province *(17)*.

The first soil survey of a small part of Stutsman County was published in 1903 *(5)*. Another part of Stutsman County, the James River Valley, was included in the soil survey of La Moure County published in 1971 *(12)*. A general soil map of Stutsman County was published in 1963 and was described in a report published in 1968 *(10)*. A general soil map and report published in 1968 *(9)* also included information about Stutsman County.

General Nature of the County

This section provides general information about the county. It describes physiography, relief, and drainage; history and development; transportation facilities; water supply; and climate.

Physiography, Relief, and Drainage

The Pierre Formation underlies the glacial drift of Stutsman County. The subsurface elevation of this formation ranges from 1,400 to 1,500 feet beneath the Drift Prairie, which is just west of Jamestown, to 1,870 feet beneath the Missouri Coteau. This 300-foot rise in elevation, called the Missouri Escarpment, has been and is the single greatest influence on the drainage in Stutsman County. The surface elevation is more than

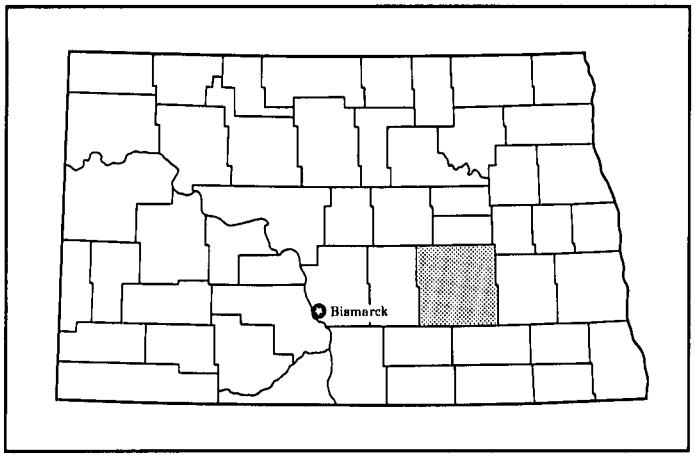

Figure 1.—Location of Stutsman County in North Dakota.

2,000 feet in the western part of the county and is 1,340 feet in the James River Valley in the southeastern part of the county *(17)*.

During the Wisconsin era of glaciation, the Missouri Escarpment was largely responsible for restricting the southward and westward movement of the glacier. Because of this extensive stagnation of ice flow, a landform characterized by hummocky moraines and a closed drainage system was created along the Missouri Escarpment. Large outwash plains developed to the west of these moraines because of glacial meltwater flowing west to the Missouri River. The Marstonmoor aquifer underlies large areas of the western part of the county.

Actively flowing ice planed the landscape east of the Missouri Escarpment, resulting in ground moraines with low relief. Except for areas with glacial landforms, such as recessional moraines, kames, or eskers, this low relief created large areas of poorly drained, saline soils, most noticeably in the Courtenay area.

With the retreat of the glacial ice sheet to the north, meltwater flowing to the south created the Pipestem River and James River systems. Minor meltwater channels, such as Minneapolis Flats Creek, Beaver Creek, and Seven Mile Coulee, also were created.

The James River, which flows southward, is the main drainage system today in Stutsman County. Pipestem Creek, Buffalo Creek, and Beaver Creek enter the James River from the west and drain the areas between the Missouri Escarpment and the James River. Minneapolis Flats Creek flows northward along the Missouri Escarpment and drains into Pipestem Creek northwest of Jamestown. Seven Mile Coulee and Steaman Coulee are the only streams entering the James River from the east.

History and Development

The oldest known human bones found in North Dakota, thought to be about 3,500 years old, were uncovered by erosion along Pipestem Creek in Stutsman County. These three individuals were probably members of a migratory, hunting and gathering tribe.

About 1,500 years ago, Plains Woodland Native Americans built permanent villages in what is now Stutsman County. Artifacts and beans, corn, and squash seeds found in excavated pits provide evidence that these people apparently depended upon agriculture for their subsistence.

By the time Europeans entered what is now Stutsman County from the east, the Plains Sioux, who were the predominate American Indians in the area, had already moved further west.

In 1853, the U.S. Congress commissioned the War Department to find the best route from the Mississippi River to the Pacific Ocean. In 1864, in order to link the east to the west along this route, the Northern Pacific Railroad was granted approximately 39 million acres of land, including 11 million acres in North Dakota. The railroad reached Jamestown in 1872 and brought settlers to the area. By 1878, homesteaders had broken about 3,780 acres of sod in the county. By 1882, the population of Jamestown was 1,200 and by 1885 that population had doubled *(11)*.

Currently in Stutsman County, a little more than 1,045,000 acres on 1,159 farms is used as cropland. Jamestown is the largest community in the county and has a population of about 15,000. Other communities include Medina, Streeter, Montpelier, Courtenay, Woodworth, and Cleveland. The remainder of the population is rural.

Transportation Facilities

The main east-west routes in the county are Interstate 94 and North Dakota Highway 46. In the northwestern part of the county, the main east-west route is North Dakota Highway 36. The major north-south route in the county is U.S. Highway 281. Other north-south routes include North Dakota Highway 20 and North Dakota Highway 30. These highways and the other paved and gravel roads provide a good transportation system. The county also is served by commuter airlines and railroads.

Water Supply

The water supply in Stutsman County generally comes from surface water, such as the James River; deep wells of the Dakota Sandstone or Pierre Shale; or

surface or buried aquifers resulting from glaciofluvial deposits. The major surface aquifers are the Marstonmoor Plain, Golden, Jamestown, Seven Mile Coulee, Plainview, and Medina aquifers and the major buried aquifers are the Klose, Homer, Spiritwood, Courtenay, Upper Buffalo Creek, and Street aquifers.

The largest aquifers are those in glaciofluvial deposits. Generally, the surface aquifers are recharged from rainfall, snowmelt, and lateral subsurface movement from local water sources. The Jamestown aquifer, from which Jamestown extracts its water, is recharged from the James River and is both surface and artesian in nature *(7)*.

Both water extracted from the Dakota Sandstone and Pierre Shale and water from glaciofluvial sources is hard water because of dissolved salts. The water derived from bedrock has a higher level of soluble salts, such as chloride or fluoride, which can be detrimental to livestock and plants. The main salt in water derived from glaciofluvial sources is calcium carbonate.

Climate

Stutsman County is usually quite warm in summer. It has frequent spells of hot weather and occasional cool days. It is very cold in winter, when arctic air frequently surges over the survey area. Precipitation occurs mainly during the warm period and is normally greatest in late spring and early summer. Winter snowfall is generally not too heavy, and it is blown into drifts, so that much of the ground is free of snow. Several times each winter, storms with snow and high winds bring blizzard conditions to the survey area. Hail falls in scattered, small areas during summer thunderstorms.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Jamestown, North Dakota in the period 1951 to 1987. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 11 degrees F and the average daily minimum temperature is 2 degrees. The lowest temperature on record, which occurred at Jamestown on December 23, 1983, is -37 degrees. In summer, the average temperature is 68 degrees and the average daily maximum temperature is 81 degrees. The highest recorded temperature, which occurred on July 11, 1973, is 108 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 18 inches. Of this, about 14 inches, or nearly 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 11 inches. The heaviest 1-day rainfall during the period of record was 4.9 inches at Jamestown on June 6, 1956. Thunderstorms occur on about 32 days each year.

The average seasonal snowfall is about 33 inches. The greatest snow depth at any one time during the period of record was 30 inches. On the average, 51 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge

into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such

landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

The section "Survey Procedures" explains specific procedures used to make this survey.

Survey Procedures

The general procedures used to make this survey are described in the "National Soils Handbook" of the Natural Resources Conservation Service and the "Soil Survey Manual" *(16)*. The "Major Soils of North Dakota" *(9)*, "Soil Taxonomy" *(14)*, and "Land Resource Regions and Major Land Resource Areas of the United States" *(15)*, were among the references used. The procedures used in determining the nature and characteristics of the soils are described under the heading "How This Survey Was Made."

Soil scientists traversed the land on foot and by pickup or an all-terrain vehicle at an interval close enough for them to locate contrasting soil areas of about 3 to 5 acres. All map units were characterized by transects of representative areas. Generally, one transect was recorded for each 1,000 acres of a given map unit.

Data collected from the transects were used to determine soil names and establish the range of composition of each map unit. A statistical method was used *(3)*. This statistical analysis indicates that the map unit composition given in the map unit descriptions is at least 90 percent accurate.

Each map unit was documented by at least one pedon description for each soil series identified in its name. Laboratory data were collected in 1984, 1985, and 1986 on sixteen pedons sampled for engineering properties. The analyses were made by the North Dakota State Highway Department.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

As a result of changes in series concepts, the location of moisture regime areas, differing soil patterns, and differences in the design of the associations, some of the soil boundaries and soil names on the general soil map of this county do not match those on the maps of Barnes, Foster, Kidder, La Moure, and Wells Counties, North Dakota.

Soil Descriptions

Level to very steep, loamy soils on glacial till plains and moraines

These soils formed in glacial till. They make up about 84 percent of the county. Surface water flows into drainageways and streams in some areas, but in other areas it collects in depressions. In most areas these soils are suited to cultivated crops and hay. They are also suited to range and pasture.

1. Barnes-Svea Association

Very deep, level to undulating, well drained and moderately well drained, medium textured soils

This association is on rises and in swales on till plains. The landscape includes scattered depressions and flats. Surface water flows mostly into depressions; however, some of it flows into streams. Slope ranges from 0 to 6 percent.

This association makes up about 36 percent of the county. It is about 35 percent Barnes soils, 30 percent Svea soils, and 35 percent soils of minor extent.

The well drained Barnes soils are on rises. Typically, the surface layer is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam.

The moderately well drained Svea soils are in swales. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam.

Buse, Cresbard, Hamerly, Parnell, and Tonka soils are the principal minor soils in this association. The Buse soils have a calcareous subsoil. They are on knolls. The moderately well drained Cresbard soils have a dense, sodic subsoil. They are in swales. The somewhat poorly drained Hamerly soils have an accumulation of lime within a depth of 16 inches. They are on flats adjacent to depressions. The very poorly drained Parnell and poorly drained Tonka soils have an accumulation of clay in the subsoil. They are in depressions.

In most areas this association is used for cultivated crops. It is suited to small grain and sunflowers and to range and pasture. The main concerns in managing cultivated areas are controlling water erosion, maintaining tilth, and overcoming wetness in areas of the Parnell and Tonka soils.

2. Barnes-Buse Association

Very deep, gently rolling and rolling, well drained, medium textured soils

This association is on knolls, summits, shoulder slopes, and side slopes on till plains and moraines. The landscape includes scattered swales, flats, and

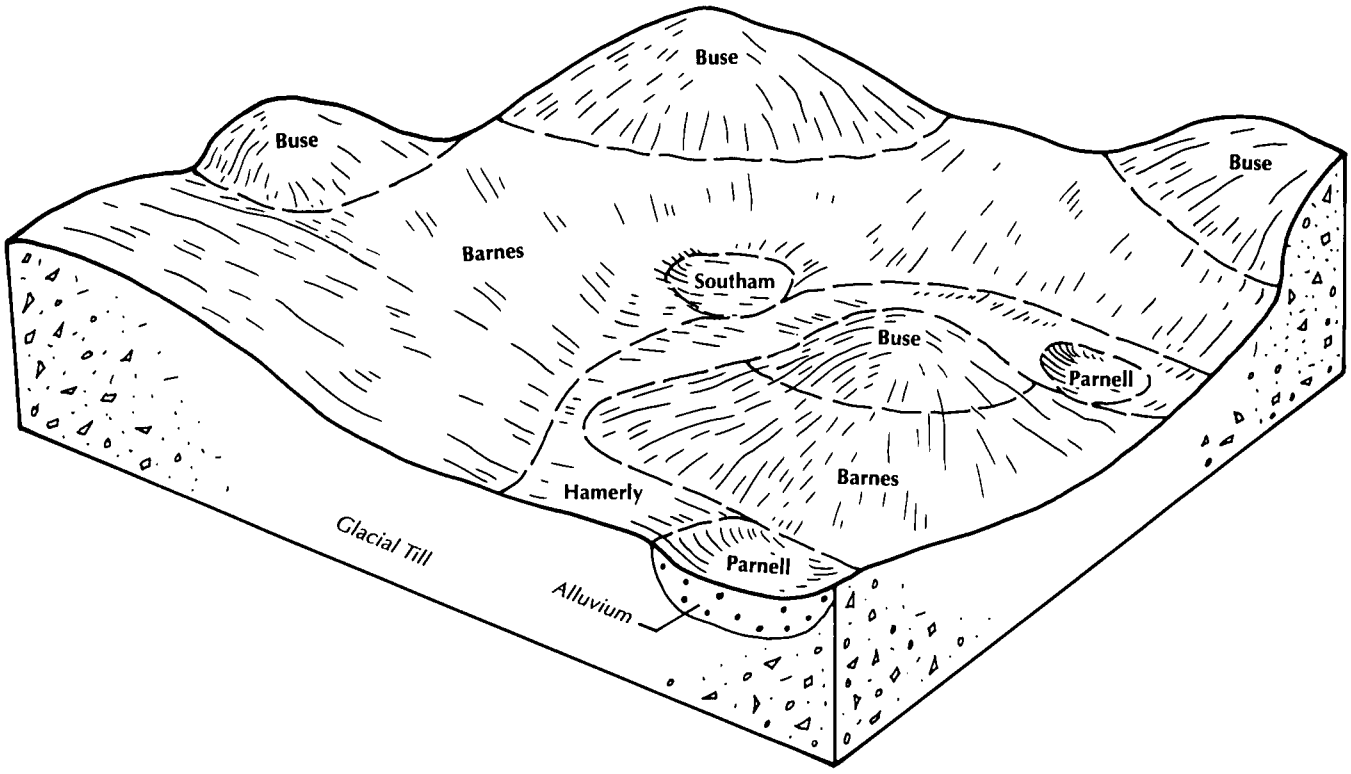

Figure 2.—Typical pattern of soils and parent material in the Barnes-Buse association.

depressions. In most areas surface water flows into streams, but in some areas it collects in depressions. Slope ranges from 6 to 15 percent.

This association makes up about 30 percent of the county. It is about 45 percent Barnes soils, 20 percent Buse soils, and 35 percent soils of minor extent (fig. 2).

The Barnes soils are on side slopes and summits. Typically, the surface layer is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam.

The Buse soils are on shoulder slopes and knolls. Typically, the surface layer is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam.

Hamerly, Parnell, and Southam soils are the principal minor soils in this association. The somewhat poorly drained Hamerly soils have an accumulation of lime within a depth of 16 inches. They are on flats adjacent to depressions. The very poorly drained Parnell and Southam soils are in depressions. The Parnell soils have an accumulation of clay in the subsoil. The Southam soils are almost continuously ponded.

In most areas this association is used for cultivated crops. In some areas it is used for range. The gently rolling soils are suited to small grain and sunflowers and to range and pasture. The rolling soils are better suited to range or pasture. The main concern in managing cultivated areas is controlling water erosion and soil blowing. The main concerns in managing range are maintaining an adequate cover of the important range or pasture plants and achieving a uniform distribution of grazing.

3. Barnes-Buse-Svea Association

Very deep, rolling to very steep, well drained, medium textured soils

This association is on foot slopes, side slopes, shoulder slopes, and summits on moraines. The landscape includes scattered depressions. In most areas surface water flows into streams, but in some areas it collects in depressions. Slope ranges from 9 to 50 percent.

This association make up about 9 percent of the county. It is about 35 percent Barnes soils, 25 percent Buse soils, 20 percent Svea soils, and 20 percent soils of minor extent.

The rolling and hilly Barnes soils are on side slopes and summits. Typically, the surface layer is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam.

The rolling to very steep Buse soils are on shoulder slopes and summits. Typically, the surface layer is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam.

The rolling and hilly Svea soils are on side slopes and foot slopes. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam.

Parnell, Sioux, and Southam soils are the principal minor soils in this association. The very poorly drained Parnell and Southam soils are in depressions. The Parnell soils have an accumulation of clay in the subsoil. The Southam soils are almost continuously ponded. The excessively drained Sioux soils have a gravelly substratum. They are on shoulder slopes.

In most areas this association is used for range. In scattered small areas it is used for cultivated crops. These soils are best suited to range. The main concerns in managing range are maintaining an adequate cover of the important native forage plants and achieving a uniform distribution of grazing.

4. Cresbard-Barnes-Svea Association

Very deep, level to undulating, moderately well drained and well drained, medium textured soils

This association is on rises and in swales on till plains. The landscape includes scattered depressions and flats. Surface water flows into depressions. Slope ranges from 0 to 6 percent.

This association makes up about 4 percent of the county. It is about 30 percent Cresbard soils, 25 percent Barnes soils, 15 percent Svea soils, and 30 percent soils of minor extent.

The moderately well drained, sodic Cresbard soils are in swales. Typically, the surface layer is black loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 2 inches thick. The next layer is very dark grayish brown clay loam about 5 inches thick. The subsoil is about 14 inches thick. It is very dark grayish brown clay loam in the upper part, dark grayish brown clay loam in the next part, and light brownish gray, calcareous loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam.

The well drained Barnes soils are on rises. Typically, the surface layer is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam.

The moderately well drained Svea soils are in swales. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam.

Buse, Hamerly, Parnell and Tonka soils are the principal minor soils in this association. The Buse soils have a calcareous subsoil. They are on knolls. The somewhat poorly drained Hamerly soils have an accumulation of lime within a depth of 16 inches. They are on flats adjacent to depressions. The very poorly drained Parnell soils and the poorly drained Tonka soils have an accumulation of clay in the subsoil. They are in depressions.

In most areas this association is used for cultivated crops. It is suited to small grain and sunflowers and to range and pasture. In most years crop growth is uneven in areas of the Cresbard soil because of moisture stress, the dense subsoil, and salts. The main concerns in managing cultivated areas are maintaining tilth and controlling water erosion. Other management concerns are controlling soil blowing in areas of the Hamerly soils and overcoming wetness in areas of the Parnell and Tonka soils.

5. Hamerly-Svea-Barnes Association

Very deep, level to undulating, somewhat poorly drained to well drained, medium textured soils

This association is on flats and rises and in swales on till plains. The landscape includes scattered depressions. Surface water flows into depressions. Slope ranges from 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 35 percent Hamerly soils, 20 percent

Svea soils, 10 percent Barnes soils, and 35 percent soils of minor extent.

The level and nearly level, somewhat poorly drained, highly calcareous Hamerly soils are on flats. Typically, the surface layer is black, calcareous loam about 9 inches thick. The subsoil is light olive brown loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled loam.

The level to undulating, moderately well drained Svea soils are in swales. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam.

The well drained Barnes soils are on rises. Typically, the surface layer is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam.

Colvin, Parnell, Tonka, and Vallers soils are the principal minor soils in this association. The poorly drained and very poorly drained Colvin soils are silty clay loam throughout. They are on flats and in shallow depressions. The very poorly drained Parnell soils and the poorly drained Tonka soils have an accumulation of clay in the subsoil. They are in depressions. The poorly drained Vallers soils are moderately saline. They are on flats.

In most areas this association is used for cultivated crops. It is suited to small grain and sunflowers and to range and pasture. The main concerns in managing cultivated crops are controlling soil blowing and water erosion, maintaining tilth, and overcoming wetness in areas of the Colvin, Parnell, Tonka, and Vallers soils.

Level to undulating, silty soils on lake plains

These soils formed in glaciolacustrine deposits. They make up about 1 percent of the county. Surface water flows into depressions and drainageways. These soils are suited to cultivated crops, hay, pasture, and range.

6. Sinai-Overly-Bearden Association

Very deep, level to undulating, moderately well drained and somewhat poorly drained, moderately fine textured soils

This association is on rises and flats and in swales on lake plains. Slope ranges from 0 to 6 percent.

This association makes up about 1 percent of the county. It is about 30 percent Sinai soils, 20 percent Overly soils, 10 percent Bearden soils, and 40 percent soils of minor extent.

The level to undulating, moderately well drained Sinai soils are on flats and rises. Typically, the surface layer is black and about 8 inches thick. It is silty clay loam in the upper part and silty clay in the lower part. The subsoil is silty clay about 21 inches thick. It is very dark grayish brown in the upper part and dark grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay.

The level to undulating, moderately well drained Overly soils are on rises. Typically, the surface soil is black silty clay loam about 14 inches thick. The subsoil is silty clay loam about 18 inches thick. It is black in the upper part and dark grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay loam.

The level, somewhat poorly drained, highly calcareous Bearden soils are in swales. Typically, the surface layer is black, calcareous silty clay loam about 8 inches thick. The mottled, calcareous subsoil is about 29 inches thick. It is dark grayish brown silty clay loam in the upper part, light olive brown silty clay loam in the next part, and light olive brown silt loam in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled, and calcareous. It is silt loam in the upper part and loam in the lower part.

Aberdeen, Colvin, and Fargo soils are the principal minor soils in this association. The moderately well drained Aberdeen soils have a dense, sodic subsoil. They are on flats. The poorly drained and very poorly drained Colvin soils have an accumulation of lime within a depth of 16 inches. They are in swales and shallow depressions. The poorly drained Fargo soils have a subsoil and substratum of silty clay. They are in swales.

In most areas this association is used for cultivated crops. It is suited to small grain and sunflowers and to range and pasture. The main concern in managing cultivated crops is controlling water erosion and soil blowing. Other management concerns are maintaining tilth and overcoming wetness in areas of the Colvin and Fargo soils.

Level to undulating, loamy and sandy soils on mantled till plains and outwash plains

These soils formed in eolian soil material, glacial till, and glaciofluvial deposits. They make up about 3 percent of the county. Surface water flows into

drainageways and shallow depressions. These soils are suited to cultivated crops, hay, range, and pasture.

7. Swenoda-Hecla Association

Very deep, level to undulating, moderately well drained, moderately coarse textured and coarse textured soils

This association is on flats and rises and in swales on mantled till plains and outwash plains. The landscape includes scattered knolls. Slope ranges from 0 to 6 percent.

This association makes up about 3 percent of the county. It is about 45 percent Swenoda soils, 15 percent Hecla soils, and 40 percent soils of minor extent.

The Swenoda soils are in swales. Typically, the surface soil is fine sandy loam about 11 inches thick. It is black in the upper part and very dark brown in the lower part. The subsoil is about 32 inches thick. It is very dark brown fine sandy loam in the upper part, dark brown fine sandy loam in the next part, and grayish brown, calcareous loam in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam.

The Hecla soils are on flats and rises. Typically, the surface soil is black loamy fine sand about 17 inches thick. The next layer is very dark grayish brown loamy sand about 6 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, mottled loamy sand.

Buse, Hamerly, Svea, and Towner soils are the principal minor soils in this association. The well drained Buse soils and the moderately well drained Svea soils are loam throughout. The Buse soils are on knolls. The Svea soils are in swales. The somewhat poorly drained Hamerly soils have an accumulation of lime within a depth of 16 inches. They are on flats. The upper part of the subsoil in the moderately well drained Towner soils is loamy sand. These soils have a substratum of loam. They are on rises.

In most areas this association is used for cultivated crops. It is suited to small grain and sunflowers and to range and pasture. The main concerns in managing cultivated areas are controlling soil blowing and overcoming droughtiness. Other management concerns are maintaining tilth and controlling water erosion in areas of the Buse and Svea soils.

Level to steep, loamy soils on outwash plains

These soils formed in glaciofluvial deposits. They make up about 5 percent of the county. Surface water flows into depressions and drainageways. These soils are poorly suited to cultivated crops, hay, and pasture. They are better suited to range and pasture.

8. Sioux-Arvilla Association

Very deep, level to steep, excessively drained and somewhat excessively drained, moderately coarse textured soils

This association is on ridges, knolls, and flats on outwash plains. The landscape includes scattered linear swales. Slope ranges from 0 to 35 percent.

This association makes up about 5 percent of the county. It is about 45 percent Sioux soils, 20 percent Arvilla soils, and 35 percent soils of minor extent.

The nearly level to steep, excessively drained Sioux soils are on ridges, knolls, and flats. Typically, the surface layer is black sandy loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand.

The level to hilly, somewhat excessively drained Arvilla soils are on ridges, knolls, and flats. Typically, the surface layer is black sandy loam about 8 inches thick. The subsoil is very dark grayish brown sandy loam about 7 inches thick. The substratum to a depth of about 60 inches is dark brown, calcareous gravelly sand.

Divide and Fordville soils are the principal minor soils in this association. The somewhat poorly drained Divide soils have an accumulation of lime within a depth of 16 inches. They are on flats in linear swales. The well drained Fordville soils have a substratum of gravelly sand at a depth of 20 to 40 inches and a surface layer and subsoil of loam. They are on flats.

The level to gently rolling areas are generally used for cultivated crops. The rolling to steep areas are mostly used for range. The main concerns in managing cultivated areas are controlling soil blowing and overcoming droughtiness. The main concerns in managing range are maintaining an adequate cover of the important native forage plants and achieving a uniform distribution of grazing.

Level to very steep, loamy and silty soils in stream valleys

These soils formed in glacial till, alluvium, glaciofluvial deposits, and material weathered from shale bedrock. They make up about 7 percent of the county. Surface water flows into streams. These soils are poorly suited to cultivated crops. They are better suited to range, pasture, or hay.

9. Kloten-Buse-Lamoure Association

Shallow and very deep, level to very steep, well drained and poorly drained, medium and moderately fine textured soils

This association is on flood plains and valley side slopes and shoulder slopes. Surface water flows into streams. Slope ranges from 0 to 50 percent.

This association makes up about 1 percent of the county. It is about 40 percent Kloten soils, 30 percent Buse soils, 10 percent Lamoure soils, and 20 percent soils of minor extent.

The strongly sloping to very steep, shallow, well drained Kloten soils are on side slopes and shoulder slopes. Typically, the surface layer is black loam about 6 inches thick. The next layer is very dark grayish brown loam about 4 inches thick. Below this is shale bedrock.

The strongly sloping to very steep, very deep, well drained Buse soils are on shoulder slopes. Typically, the surface layer is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam.

The level, very deep, poorly drained Lamoure soils are in swales and oxbows on flood plains. Typically, the surface soil is silty clay loam about 35 inches thick. It is black in the upper part, black and calcareous in the next part, and very dark gray and calcareous in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is dark gray in the upper part and dark olive gray in the lower part.

Darnen and La Prairie soils are the principal minor soils in this association. The Darnen soils are well drained. They are loam throughout. They are on foot slopes. The La Prairie soils are moderately well drained. They are on flats on flood plains.

In most areas this association is used for range or pasture. It is best suited to these uses. Because of meandering stream channels, the Lamoure soils are generally unsuited to cultivated crops. Areas are too small and irregularly shaped to till. The main concerns in managing range are maintaining an adequate cover of the important native forage plants and achieving a uniform distribution of grazing.

10. Buse-La Prairie-Sioux Association

Very deep, level to very steep, well drained, moderately well drained, and excessively drained, medium textured and moderately coarse textured soils

This association is on valley shoulder slopes, terraces, and flood plains. Surface water flows into streams. Slope ranges from 0 to 50 percent.

This association makes up about 2 percent of the county. It is about 25 percent Buse soils, 15 percent La Prairie soils, 10 percent Sioux soils, and 50 percent soils of minor extent (fig. 3).

The moderately steep to very steep, well drained Buse soils are on shoulder slopes in stream valleys. Typically, the surface layer is black loam about 7 inches thick. The subsoil is loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam.

The level and nearly level, moderately well drained La Prairie soils are on flats on flood plains. Typically, the surface soil is black silt loam about 14 inches thick. The subsoil is calcareous. It is black silt loam in the upper part, dark grayish brown silt loam in the next part, and dark brown loam to a depth of about 60 inches in the lower part.

The nearly level to moderately sloping, excessively drained Sioux soils are on terraces. Typically, the surface layer is black sandy loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand.

Darnen, Fordville, Lamoure, and Svea soils are the principal minor soils in this association. The Darnen and Svea soils are loam throughout. They are on foot slopes. The Fordville soils have a substratum of gravelly sand within a depth of 20 to 40 inches. The poorly drained Lamoure soils are silty clay loam throughout. They are in swales and oxbows on flood plains.

In most areas this association is used for cultivated crops, range, or pasture. The rolling to very steep areas are mostly used for range. They are best suited to this use. The level to gently rolling areas are suited to cultivated crops. The main concerns in managing cultivated areas are controlling soil blowing and water erosion and overcoming droughtiness. Rare flooding also is a concern in areas of the La Prairie soils. The main concerns in managing range are maintaining an adequate cover of the important native forage plants and achieving a uniform distribution of grazing.

11. Sioux-Fordville-Lamoure Association

Very deep, level to gently rolling, excessively drained, well drained, and poorly drained, moderately coarse textured, medium textured, and moderately fine textured soils

This association is on terraces and flood plains in stream valleys. Surface water flows into streams. Slope ranges from 0 to 9 percent.

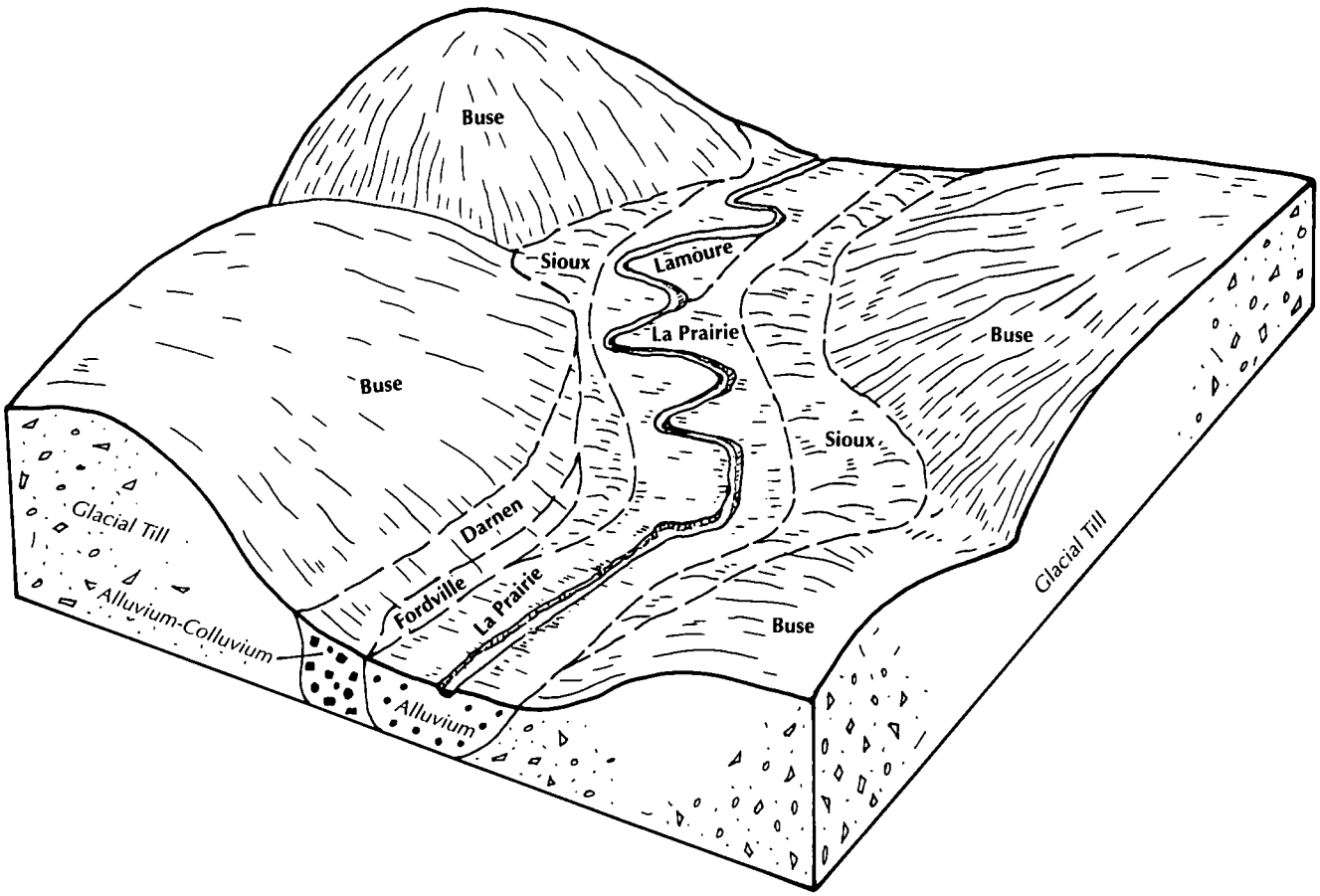

Figure 3.—Typical pattern of soils and parent material in the Buse-La Prairie-Sioux association.

This association makes up about 4 percent of the county. It is about 30 percent Sioux soils, 15 percent Fordville soils, 10 percent Lamoure soils, and 45 percent soils of minor extent.

The nearly level to gently rolling, excessively drained Sioux soils are on flats, rises, and ridges on terraces. Typically, the surface layer is black sandy loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand.

The level to undulating, well drained Fordville soils are on flats and in swales on terraces. Typically, the surface soil is black loam about 11 inches thick. The subsoil is loam about 16 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The next layer is dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous gravelly sand.

The level, poorly drained Lamoure soils are in oxbows and swales on flood plains. Typically, the surface soil is silty clay loam about 35 inches thick. It is black in the upper part, black and calcareous in the next part, and very dark gray and calcareous in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is dark gray in the upper part and dark olive gray in the lower part.

Clontarf, Divide, La Prairie, and Marysland soils are the principal minor soils in this association. The well drained Clontarf soils have a surface layer and subsoil of fine sandy loam. They are on rises. The somewhat poorly drained Divide and poorly drained Marysland soils have an accumulation of lime within a depth of 16 inches. Divide soils are on flats. Marysland soils are in shallow depressions. The moderately well drained La Prairie soils have a surface layer of silt loam and a subsoil of silt loam and loam. They are on flats on flood plains.

In most areas this association is used for range,

pasture, or hay. In some areas it is used for cultivated crops. The main concerns in managing cultivated areas are controlling soil blowing, overcoming droughtiness, and overcoming wetness and flooding in areas of the Lamoure soils. The main concerns in managing range are maintaining an adequate cover of the important native forage plants and achieving a uniform distribution of grazing.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Colvin silty clay loam is a phase of the Colvin series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Swenoda-Buse complex, 6 to 9 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Hamerly, Vallers, and Colvin soils, saline, 0 to 3 percent slopes, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

As a result of changes in series concepts, the location of moisture regime areas, differing soil patterns, and differences in the design of the map units, some of the soil boundaries and soil names on the detailed soil map of this county do not match those on the maps of Barnes, Foster, Kidder, La Moure, and Wells Counties, North Dakota.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

1—Southam silty clay loam. This very deep, level, very poorly drained, calcareous soil is in depressions on till plains and lake plains. It is ponded. Individual areas range from about 3 to more than 600 acres in size.

Typically, the surface soil is black and calcareous. It

is about 27 inches thick. It is silty clay loam in the upper part, silty clay in the next part, and clay loam in the lower part. The substratum to a depth of about 60 inches is calcareous silty clay. It is dark greenish gray in the upper part and dark gray in the lower part. In some places the surface soil is only 10 to 26 inches thick. In other places the soil is silty clay loam throughout.

Included with this soil in mapping are small areas of Hamerly, Parnell, and Vallers soils. These soils make up about 5 to 20 percent of the unit. The Hamerly and Vallers soils are on flats surrounding the depressions. The Hamerly soils are somewhat poorly drained. The Vallers soils are poorly drained and saline. The Parnell soils have an accumulation of clay in the subsoil. They are along the rim of the depressions.

Permeability is slow in the Southam soil, and runoff is ponded. Available water capacity is high. The seasonal high water table is 5 feet above to 1 foot below the surface.

Most areas are used as wetland wildlife habitat. This soil is best suited to this use. It generally is unsuited to cultivated crops, range, and pasture and to the trees and shrubs grown as windbreaks and environmental plantings because of the ponding and the difficulty in locating suitable drainage outlets. Areas of this soil and the ponded water provide excellent winter cover for resident wildlife and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are minimizing siltation and maintaining the natural water level.

The land capability classification is VIIIw. No range site or pasture group is assigned. The productivity index for spring wheat is 0.

2—Parnell silty clay loam. This very deep, level, very poorly drained soil is in depressions on till plains and moraines. It is ponded. Individual areas range from about 3 to more than 80 acres in size.

Typically, the surface soil is silty clay loam about 16 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is silty clay about 20 inches thick. It is very dark gray in the upper part and very dark grayish brown in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled loam. In some places the surface layer is silty clay. In other places the soil has a light colored subsurface layer.

Included with this soil in mapping are small areas of Hamerly, Southam, and Vallers soils. These soils make up about 5 to 20 percent of the unit. The Hamerly and Vallers soils are on flats surrounding the depressions. The Hamerly soils are somewhat poorly drained. The Vallers soils are poorly drained. The Southam soils do not have an accumulation of clay in the subsoil. They are in the deeper part of the depressions.

Permeability is slow in the Parnell soil, and runoff is ponded. Available water capacity is high. The seasonal high water table is 2 feet above to 2 feet below the surface. Tilth is fair.

Most areas are used for hay or wetland wildlife habitat. Some areas are used for range or pasture. Some areas are drained and cultivated. If drained, this soil is suited to wheat, sunflowers, barley, and flax and to grasses and legumes for hay and pasture. If undrained, it is best suited to hay, range, and wetland wildlife habitat. Because locating suitable drainage outlets is often difficult, few areas are drained. In undrained areas crops are planted and harvested in only about 2 years out of 10. The hazards of water erosion and soil blowing are slight. In areas where the soil is drained and cultivated, applying a system of conservation tillage that leaves crop residue on the surface helps to control erosion and provides food and cover for resident and migratory wildlife.

Areas of this soil and the ponded water provide excellent winter cover for resident wildlife and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are minimizing siltation and maintaining the natural water level.

In areas where this soil is used for range, the important native forage plants are slough sedge and rivergrass. If this soil is drained, creeping foxtail and reed canarygrass are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings.

The land capability classification is IIIw. The range site is Wetland. In drained areas the pasture group is Wet. The productivity index for spring wheat ranges from 20 to 75, depending on the degree of drainage.

3—Tonka silt loam. This very deep, level, poorly drained soil is in shallow depressions on till plains. It is ponded. Individual areas range from about 3 to more than 80 acres in size.

Typically, the surface layer is black silt loam about 11

inches thick. The subsurface layer is very dark gray, mottled silt loam about 11 inches thick. The subsoil is black, mottled silty clay about 19 inches thick. The next layer is dark gray, mottled silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, calcareous silt loam. In some places the surface layer is silty clay loam. In other places the soil does not have a subsurface layer.

Included with this soil in mapping are small areas of Hamerly and Vallers soils. These soils make up about 5 to 15 percent of the unit. They have an accumulation of lime within a depth of 16 inches. They are on flats surrounding the depressions.

Permeability is slow in the Tonka soil, and runoff is ponded. Available water capacity is high. The seasonal high water table is 0.5 foot above to 1.0 foot below the surface. Tilth is good.

Most areas are used for hay or wetland wildlife habitat. Some areas are used for range or pasture. Some areas are drained and cultivated. If drained, this soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are controlling wetness and ponding. Because locating suitable drainage outlets is often difficult, few areas are drained. In undrained areas crops are planted and harvested in only about 5 to 7 years out of 10, and seeding is often delayed. In areas where the soil is drained and cultivated, a system of conservation tillage that leaves crop residue on the surface helps to control erosion and provides food and cover for resident and migratory wildlife.

Areas of this soil and the ponded water provide high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are minimizing siltation and maintaining the natural water level.

In areas where this soil is used for range, the important native forage plants are slim sedge, wooly sedge, and prairie cordgrass. Creeping foxtail, reed canarygrass, and alsike clover are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings.

The land capability classification is IIw. The range site is Wet Meadow. The pasture group is Wet. The productivity index for spring wheat ranges from 40 to 85, depending on the degree of drainage.

4—Hamerly-Parnell complex, 0 to 3 percent slopes. These very deep soils are on till plains. The level and nearly level, somewhat poorly drained, highly calcareous Hamerly soil is on flats between depressions. The level, very poorly drained Parnell soil is in depressions. Individual areas of this unit range from about 5 to more than 640 acres in size. They are about 45 to 60 percent Hamerly soil and 35 to 50 percent Parnell soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Hamerly soil is black, calcareous loam about 9 inches thick. The subsoil is light olive brown, calcareous loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the soil is slightly saline. In other places the substratum is gray.

Typically, the surface soil of the Parnell soil is silty clay loam about 16 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is silty clay about 20 inches thick. It is very dark gray in the upper part and very dark grayish brown in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled loam. In some places the surface layer is silty clay. In other places the soil has a light colored subsurface layer.

Included with these soils in mapping are small areas of Cresbard, Southam, Svea, and Vallers soils. These included soils make up about 5 to 10 percent of the unit. The Cresbard and Svea soils are moderately well drained. They are on rises. The Southam soils do not have an accumulation of clay in the subsoil. They are in the deeper part of the depressions. The Vallers soils are poorly drained. They are intermingled with areas of the Hamerly soil.

Permeability is moderately slow in the Hamerly soil and slow in the Parnell soil. Runoff is slow on the Hamerly soil and ponded on the Parnell soil. Available water capacity is high in both soils. The seasonal high water table is at a depth of 2 to 4 feet in the Hamerly soil and 2 feet above to 2 feet below the surface in the Parnell soil. Tilth is fair.

Most areas are used for cultivated crops, hay, or wetland wildlife habitat. The hazard of water erosion is slight. The hazard of soil blowing is moderate on the Hamerly soil and slight on the Parnell soil. The main

management concerns in cultivated areas are controlling soil blowing on the Hamerly soil and overcoming the wetness of the Parnell soil. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage can increase the salinity. In undrained areas of the Parnell soil, crops are planted and harvested in only about 2 years out of 10. Applying a system of conservation tillage that leaves crop residue on the surface and establishing windbreaks helps to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

The Parnell soil provides excellent winter cover for resident wildlife and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wildlife habitat are minimizing siltation and maintaining the natural water level.

In areas where these soils are used for range, the important native forage plants are little bluestem, big bluestem, slough sedge, and rivergrass. Big bluestem, switchgrass, smooth bromegrass, and sweetclover are suitable hay and pasture plants in areas of the Hamerly soil. If the Parnell soil is drained, creeping foxtail and reed canarygrass are suitable hay and pasture plants. The soil blowing in areas of the Hamerly soil is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing. Compaction, trampling, and root shearing are problems in areas of the Parnell soil, especially if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

The Hamerly soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. If drained, the Parnell soil is suited to the climatically adapted species. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on these soils are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Hamerly soil is IIe, and that of the Parnell soil is IIIw. The range site of the Hamerly soil is Limy Subirrigated, and that of the Parnell soil is Wetland. The pasture group of the Hamerly soil is Limy Subirrigated, and that of drained areas of the Parnell soil is Wet. The productivity index of the unit for spring wheat ranges from 45 to 80, depending on the degree of drainage in areas of the Parnell soil.

5—Hamerly-Tonka complex, 0 to 3 percent slopes. These very deep soils are on till plains. The level and nearly level, somewhat poorly drained, highly calcareous Hamerly soil is on flats between depressions. The level, poorly drained Tonka soil is in depressions. Individual areas of this unit range from about 5 to more than 640 acres in size. They are about 45 to 60 percent Hamerly soil and 25 to 40 percent Tonka soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Hamerly soil is black, calcareous loam about 9 inches thick. The subsoil is light olive brown, calcareous loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the soil is slightly saline. In other places the substratum is gray.

Typically, the surface soil of the Tonka soil is black silt loam about 11 inches thick. The subsurface layer is very dark gray, mottled silt loam about 11 inches thick. The subsoil is black, mottled silty clay about 19 inches thick. The next layer is dark gray, mottled silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, calcareous silt loam. In some places the surface soil is silty clay loam.

Included with these soils in mapping are small areas of Cresbard, Svea, and Vallers soils. These included soils make up about 10 to 20 percent of the unit. The Cresbard and Svea soils are moderately well drained. They are on rises. The Vallers soils are saline. They are intermingled with areas of the Hamerly soil.

Permeability is moderately slow in the Hamerly soil and slow in the Tonka soil. Runoff is slow on the Hamerly soil and ponded on the Tonka soil. Available water capacity is high in both soils. The seasonal high water table is at a depth of 2.0 to 4.0 feet in the Hamerly soil and 0.5 foot above to 1.0 foot below the surface in the Tonka soil. Tilth is good.

Most areas are used for cultivated crops, hay, or wetland wildlife habitat. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight. The hazard of soil blowing is moderate on the Hamerly soil and slight on the Tonka soil. The main management concerns in cultivated areas are controlling soil blowing on the Hamerly soil and overcoming the wetness of the Tonka soil. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage can increase the salinity. In undrained areas of the Tonka soil, crops are planted and harvested in only about 5 to 7 years out of 10. Applying a system of conservation tillage that leaves

crop residue on the surface and establishing windbreaks helps to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

The Tonka soil provides excellent winter cover and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wildlife habitat are minimizing siltation and maintaining the natural water level.

In areas where these soils are used for range, the important native forage plants are little bluestem, big bluestem, slim sedge, and wooly sedge. Reed canarygrass, big bluestem, switchgrass, and sweetclover are suitable hay and pasture plants. The soil blowing in areas of the Hamerly soil is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing. Compaction, trampling, and root shearing are problems on the Tonka soil, especially if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

The Hamerly soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. If drained, the Tonka soil is suited to all of the climatically adapted species. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on these soils are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Hamerly soil is IIe, and that of the Tonka soil is IIw. The range site of the Hamerly soil is Limy Subirrigated, and that of the Tonka soil is Wet Meadow. The pasture group of the Hamerly soil is Limy Subirrigated, and that of the Tonka soil is Wet. The productivity index of the unit for spring wheat ranges from 65 to 85, depending on the degree of drainage in areas of the Tonka soil.

13—Hamerly, Vallers, and Colvin soils, saline, 0 to 3 percent slopes. These very deep, highly calcareous, moderately saline soils are on flats on till plains and lake plains and in channels. The level and nearly level Hamerly soil is somewhat poorly drained. The level and nearly level Vallers soil and level Colvin soil are poorly drained. Some areas of the Colvin and Vallers soils are dissected by meandering channels, which are subject to rare flooding. Individual areas of this unit range from about 5 to more than 400 acres in size. Any individual area can consist of all Hamerly soil, all Vallers soil, all Colvin soil, or a combination of the three soils.

Typically, the surface layer of the Hamerly soil is black, calcareous loam about 9 inches thick. The subsoil is light olive brown, calcareous loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the soil is slightly saline.

Typically, the surface layer of the Vallers soil is black, calcareous silty clay loam about 7 inches thick. The subsoil is calcareous. It is about 23 inches thick. It is gray silty clay loam in the upper part and olive gray, mottled clay loam in the lower part. The substratum to a depth of about 60 inches is gray, mottled, calcareous clay loam.

Typically, the surface layer of the Colvin soil is black, calcareous silty clay loam about 7 inches thick. The subsoil is mottled, calcareous silty clay loam about 23 inches thick. It is dark gray in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is gray in the upper part and light brownish gray in the lower part. In some places the soil is strongly saline.

Included with these soils in mapping are small areas of Cresbard, Exline, Svea, and Tonka soils. These included soils make up about 5 to 10 percent of the unit. The Cresbard, Exline, and Svea soils are on rises. The Cresbard and Svea soils are moderately well drained. The Exline soils have a dense, sodic subsoil. The Tonka soils have a light colored subsurface layer. They are in depressions.

Permeability is moderately slow in the Hamerly, Vallers, and Colvin soils. Runoff is slow on the Hamerly and Vallers soils and very slow on the Colvin soil. Available water capacity is moderate in all three soils. The seasonal high water table is at a depth of 2 to 4 feet in the Hamerly soil, within a depth of 1 foot in the Vallers soil, and within a depth of 2 feet in the Colvin soil. Tilth is fair. The salinity in all three soils restricts the growth of plants.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The main management concerns in cultivated areas are overcoming the wetness and salinity and controlling the soil blowing. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage can increase the salinity. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control soil blowing

and minimize surface salinity. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Planting salt-tolerant crops and avoiding summer fallow and deep tillage help to overcome salinity.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, Nuttall alkaligrass, and inland saltgrass. Tall wheatgrass, western wheatgrass, and alsike clover are suitable hay and pasture plants. Soil blowing is a hazard. The high content of salt and the reduced amount of available water are problems, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing and minimize surface salinity. Compaction, trampling, and root shearing are problems if the range or pasture is grazed when wet. Grazing should be deferred during wet periods. Stock water ponds constructed in areas of these soils frequently contain salty water.

These soils are suited to only a few of the most salt-tolerant climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs vary in height, density, and vigor, which are affected by the reduced amount of available water caused by the salts in the soils. Reducing the evaporation rate at the surface improves seedling survival. When the bare surface of the soil dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of all three soils is IIIs. The range site is Saline Lowland. The pasture group is Saline. The productivity index of the unit for spring wheat ranges from 20 to 45, depending on the degree of drainage and salinity.

15—Hamerly loam, 0 to 3 percent slopes. This very deep, level and nearly level, somewhat poorly drained, highly calcareous soil is on flats on till plains. Individual areas range from about 5 to more than 200 acres in size.

Typically, the surface layer is black, calcareous loam about 9 inches thick. The subsoil is light olive brown, calcareous loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the surface layer and the upper part of the subsoil are silt loam. In other places the soil is slightly saline. In some areas the substratum is gray. In other areas the surface layer is noncalcareous.

Included with this soil in mapping are small areas of Cresbard, Divide, Svea, and Tonka soils. These soils make up about 5 to 15 percent of the unit. The Cresbard and Svea soils are moderately well drained. They are on rises. The Divide soils have a substratum of sand. They are in drainageways. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately slow in the Hamerly soil, and runoff is slow. Available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The main management concerns in cultivated areas are maintaining tilth and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Summer fallowing is not suitable because it can increase salinity.

In areas where this soil is used for range, the important native forage plants are little bluestem, big bluestem, and switchgrass. Smooth bromegrass, big bluestem, switchgrass, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIe. The range site and pasture group are Limy Subirrigated. The productivity index for spring wheat is 84.

16—Hamerly-Wyard loams, 0 to 3 percent slopes. These very deep, level and nearly level, somewhat poorly drained soils are on till plains. The highly calcareous Hamerly soil is on flats. The Wyard soil is in depressions. Individual areas of this unit range from about 5 to more than 400 acres in size. They are about 50 to 60 percent Hamerly soil and 30 to 45 percent Wyard soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Hamerly soil is black, calcareous loam about 9 inches thick. The subsoil is light olive brown, calcareous loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the surface layer and the upper part of the subsoil are silt loam. In other places the surface layer is noncalcareous. In some areas slope is more than 3 percent. In other areas the substratum is gray.

Typically, the surface soil of the Wyard soil is black loam about 20 inches thick. The subsoil is mottled loam about 16 inches thick. It is dark grayish brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, calcareous loam. In some places the dark color of the surface layer extends only to a depth of 8 to 15 inches. In other places the surface layer and the upper part of the subsoil are silt loam. In a few areas slope is more than 3 percent.

Included with these soils in mapping are small areas of Buse, Cresbard, Parnell, and Tonka soils. These included soils make up about 5 to 15 percent of the unit. The Buse soils are well drained. They are on knolls. The Cresbard soils are moderately well drained. They are on rises. The Parnell and Tonka soils have an accumulation of clay in the subsoil. They are in depressions.

Permeability is moderately slow in the Hamerly soil and moderate in the Wyard soil. Runoff is slow on both soils. Available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet in the Hamerly soil and at a depth of 1 to 3 feet in the Wyard soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight on both soils. The hazard of soil blowing is moderate on the Hamerly soil and slight on the Wyard soil. The main management concerns in cultivated areas are maintaining tilth and controlling soil blowing on the Hamerly soil and overcoming the early season wetness of the Wyard soil. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Delaying tillage and planting helps to overcome the early season wetness. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are little bluestem, western wheatgrass, and big bluestem. Smooth bromegrass, big bluestem, sweetclover, and alfalfa are suitable hay and pasture plants. The soil blowing in areas of the Hamerly soil is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

These soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Hamerly soil is IIe, and that of the Wyard soil is IIw. The range site of the Hamerly soil is Limy Subirrigated, and that of the Wyard soil is Overflow. The pasture group of the Hamerly soil is Limy Subirrigated, and that of the Wyard soil is Overflow and Run-on. The productivity index of the unit for spring wheat is 83.

18—Hamerly-Svea loams, 0 to 3 percent slopes. These very deep, level and nearly level soils are on till plains. The somewhat poorly drained, highly calcareous Hamerly soil is on flats. The moderately well drained Svea soil is on rises. Individual areas of this unit range from about 5 to more than 400 acres in size. They are about 50 to 65 percent Hamerly soil and 30 to 40 percent Svea soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Hamerly soil is black, calcareous loam about 9 inches thick. The subsoil is light olive brown, calcareous loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the surface layer and the upper part of the subsoil are silt loam. In other places the surface layer is noncalcareous. In some areas slope is more than 3 percent. In other areas the substratum is gray.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam. In some places the dark color of the surface layer extends to a depth of only 8 to 15 inches. In other places the subsoil is mottled throughout. In some areas the surface layer and the upper part of the subsoil are silt loam. In a few areas slope is more than 3 percent.

Included with these soils in mapping are small areas of Buse, Cresbard, Parnell, and Tonka soils. These

included soils make up about 5 to 15 percent of the unit. The Buse soils are well drained. They are on knolls. The Cresbard soils have a dense, sodic subsoil. They are intermingled with areas of the Svea soil. The Parnell and Tonka soils have an accumulation of clay in the subsoil. They are in depressions.

Permeability is moderately slow in the Hamerly and Svea soils. Runoff is slow. Available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet in the Hamerly soil and at a depth of 4 to 6 feet in the Svea soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight. The hazard of soil blowing is moderate on the Hamerly soil and slight on the Svea soil. The main management concerns in cultivated areas are maintaining tilth and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are little bluestem, western wheatgrass, and big bluestem. Smooth bromegrass, big bluestem, sweetclover, and alfalfa are suitable hay and pasture plants. The soil blowing in areas of the Hamerly soil is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

These soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Hamerly soil is IIe, and that of the Svea soil is IIc. The range site of the Hamerly soil is Limy Subirrigated, and that of the Svea soil is Overflow. The pasture group of the Hamerly soil is Limy Subirrigated, and that of the Svea soil is Overflow and Run-on. The productivity index of the unit for spring wheat is 87.

23B—Barnes-Svea loams, 3 to 6 percent slopes. These very deep, undulating soils are on till plains. The well drained Barnes soil is on rises. The moderately well drained Svea soil is in swales. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 65 to 80 percent Barnes soil and 15 to 30 percent Svea soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the surface layer and subsoil are thinner and lighter colored. In other places the surface layer is clay loam.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam. In some places the surface layer and subsoil are clay loam.

Included with these soils in mapping are small areas of Hamerly, Parnell, Tonka, and Vallers soils. These included soils make up about 5 to 10 percent of the unit. The Hamerly and Vallers soils are on flats. The Hamerly soils are somewhat poorly drained. The Vallers soils are poorly drained. The Parnell and Tonka soils are in depressions. The Parnell soils are very poorly drained. The Tonka soils are poorly drained.

Permeability is moderately slow in the Barnes and Svea soils. Runoff is medium. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet in the Svea soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main management concerns in cultivated areas are maintaining tilth and controlling water erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control water erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are green needlegrass, western wheatgrass, and needleandthread. Smooth bromegrass, big bluestem, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard,

especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control water erosion.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Svea soil is suited to all of the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIe. The range site is Silty. The pasture group is Loamy and Silty. The productivity index of the unit for spring wheat is 81.

23C—Barnes-Buse loams, 6 to 9 percent slopes. These very deep, gently rolling, well drained soils are on till plains and moraines. The Barnes soil is on side slopes. The Buse soil is on summits and shoulder slopes. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 60 to 75 percent Barnes soil and 20 to 30 percent Buse soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the dark color of the surface layer extends to a depth of more than 16 inches. In other places the surface layer is clay loam.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the surface layer is less than 7 inches thick and lighter colored.

Included with these soils in mapping are small areas of Hamerly, Parnell, Renshaw, Swenoda, and Tonka soils. These included soils make up about 5 to 10 percent of the unit. The Hamerly soils are somewhat poorly drained. They are on flats. The Parnell and Tonka soils are in depressions. The Parnell soils are very poorly drained. The Tonka soils are poorly drained. The Renshaw and Swenoda soils are intermingled with areas of the Barnes soil. The Renshaw soils are somewhat excessively drained. The Swenoda soils have a surface layer of fine sandy loam.

Permeability is moderately slow in the Barnes and Buse soils. Runoff is rapid. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is severe. The hazard of soil blowing is slight on the Barnes soil and moderate on the Buse soil. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, little bluestem, and needleandthread. Smooth bromegrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Buse soil is suited to only the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on this soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Barnes soil is IIIe, and that of the Buse soil is IVe. The range site of the Barnes soil is Silty, and that of the Buse soil is Thin Upland. The pasture group of the Barnes soil is Loamy and Silty, and that of the Buse soil is Thin Upland. The productivity index of the unit for spring wheat is 58.

23D—Barnes-Buse loams, 9 to 15 percent slopes. These very deep, rolling, well drained soils are on moraines. The Barnes soil is on side slopes. The Buse soil is on summits and shoulder slopes. Individual areas of this unit range from about 5 to more than 400 acres in size. They are about 50 to 60 percent Barnes soil

and 30 to 45 percent Buse soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the dark color of the surface layer extends to a depth of more than 16 inches. In other places the surface layer is clay loam. In some areas the surface is stony or gravelly. In other areas slope is 16 to 20 percent.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the surface layer is less than 7 inches thick and light colored. In other places the surface is stony or gravelly. In some areas slope is 16 to 20 percent.

Included with these soils in mapping are small areas of Hamerly, Parnell, Sioux, Southam, and Swenoda soils. These included soils make up about 5 to 10 percent of the unit. The Hamerly soils are somewhat poorly drained. They are on flats. The Parnell and Southam soils are very poorly drained. They are in depressions. The Sioux soils have a substratum of very gravelly sand. They are intermingled with areas of the Buse soil. The Swenoda soils have a surface layer of fine sandy loam. They are intermingled with areas of the Barnes soil.

Permeability is moderately slow in the Barnes and Buse soils. Runoff is rapid. Available water capacity is high.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are only poorly suited to cultivated crops. They are suited to grasses and legumes for hay and pasture. The hazard of water erosion is severe. The hazard of soil blowing is slight on the Barnes soil and moderate on the Buse soil. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, little bluestem, and needleandthread. Smooth bromegrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Buse soil generally is unsuited to the climatically adapted species. Eliminating grasses and weeds on the Barnes soil before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion. Trees and shrubs can be grown on the Buse soil for esthetic purposes or to enhance wildlife habitat if special management, such as hand or scalp planting, is applied.

The land capability classification of the Barnes soil is IVe, and that of the Buse soil is VIe. The range site of the Barnes soil is Silty, and that of the Buse soil is Thin Upland. The pasture group of the Barnes soil is Loamy and Silty, and that of the Buse soil is Thin Upland. The productivity index of the unit for spring wheat is 31.

23F—Buse-Svea loams, 15 to 50 percent slopes. These very deep, well drained soils are on moraines and dissected till plains. The hilly to very steep Buse soil is on summits and shoulder slopes. The hilly Svea soil is on side slopes. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 65 to 80 percent Buse soil and 15 to 30 percent Svea soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the surface is stony or gravelly. In other places the upper part of subsoil is brown and noncalcareous. In a few areas the surface layer is less than 7 inches thick and lighter colored. In other areas slope is more than 50 percent.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper

part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam.

Included with these soils in mapping are small areas of Lamoure and Sioux soils. These included soils make up about 5 to 10 percent of the unit. The Lamoure soils are poorly drained. They are in drainageways. The Sioux soils have a substratum of very gravelly sand. They are intermingled with areas of the Buse soil.

Permeability is moderately slow in the Buse and Svea soils. Runoff is very rapid. Available water capacity is high.

Most areas are used for range. These soils are best suited to this use. They generally are unsuited to cultivated crops, hay, and pasture and to the trees and shrubs grown as windbreaks and environmental plantings because of the slope, the moderate hazard of soil blowing on the Buse soil, and the very severe hazard of water erosion on both soils.

In areas where these soils are used as range, the important native forage plants are needleandthread, western wheatgrass, green needlegrass, and little bluestem. Water erosion and soil blowing are hazards, especially if the range is overgrazed. Maintaining an adequate cover of the important plants helps to control soil blowing and water erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

The land capability classification of the Buse soil is VIIe, and that of the Svea soil is VIe. The range site of the Buse soil is Thin Upland, and that of the Svea soil is Silty. The productivity index of the unit for spring wheat is 0.

24—Svea-Barnes loams, 0 to 3 percent slopes. These very deep, level and nearly level soils are on till plains. The moderately well drained Svea soil is in swales. The well drained Barnes soil is on rises. Individual areas of this unit range from about 5 to more than 1,000 acres in size. They are about 45 to 60 percent Svea soil and 30 to 45 percent Barnes soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam. In some places the surface layer and subsoil are clay loam. In other places the subsoil is mottled throughout. In some areas in and near the James River Valley, the lower part of the substratum is weathered shale.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the surface layer and subsoil are thinner and lighter colored. In other places the surface layer is clay loam. In some areas in and near the James River Valley, the lower part of the substratum is weathered shale.

Included with these soils in mapping are small areas of Cresbard, Fordville, Hamerly, and Tonka soils. These included soils make up about 5 to 10 percent of the unit. The Cresbard and Fordville soils are intermingled with areas of the Svea soil. The Cresbard soils have a sodic subsoil. The Fordville soils have a substratum of gravelly sand. The Hamerly soils are somewhat poorly drained. They are on flats. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately slow in the Svea and Barnes soils. Runoff is slow. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet in the Svea soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, and big bluestem. Intermediate wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. No major hazards or limitations affect the use of these soils for range or pasture.

The Svea soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Barnes soil is suited to nearly all of the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIc. The range site of the Svea soil is Overflow, and that of

the Barnes soil is Silty. The pasture group of the Svea soil is Overflow and Run-on, and that of the Barnes soil is Loamy and Silty. The productivity index of the unit for spring wheat is 91.

24B—Svea-Buse loams, 3 to 6 percent slopes. These very deep, undulating soils are on till plains. The moderately well drained Svea soil is in swales. The well drained Buse soil is on rises. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 50 to 65 percent Svea soil and 25 to 40 percent Buse soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In some places the surface layer is less than 7 inches thick and lighter colored. In other places the upper part of the subsoil is brown and noncalcareous.

Included with these soils in mapping are small areas of Cresbard, Hamerly, Swenoda, and Tonka soils. These included soils make up about 5 to 10 percent of the unit. The Cresbard and Swenoda soils are intermingled with areas of the Svea soil. The Cresbard soils have a sodic subsoil. The Swenoda soils have a surface layer of fine sandy loam. The Hamerly soils are somewhat poorly drained. They are on flats. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately slow in the Svea and Buse soils. Runoff is medium. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet in the Svea soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate. The hazard of soil blowing is slight on the Svea soil and moderate on the Buse soil. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, needleandthread, and little bluestem. Big bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control erosion.

The Svea soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Buse soil is suited to only the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on this soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Svea soil is IIe, and that of the Buse soil is IIIe. The range site of the Svea soil is Silty, and that of the Buse soil is Thin Upland. The pasture group of the Svea soil is Loamy and Silty, and that of the Buse soil is Thin Upland. The productivity index of the unit for spring wheat is 71.

24E—Barnes-Svea-Buse loams, 9 to 25 percent slopes. These very deep, well drained soils are on moraines. The rolling and hilly Barnes soil is on side slopes. The rolling Svea soil is on side slopes and foot slopes. The rolling and hilly Buse soil is on summits and shoulder slopes. Individual areas of this unit range from about 20 to more than 2,500 acres in size. They are about 35 to 50 percent Barnes soil, 20 to 35 percent Svea soil, and 15 to 30 percent Buse soil. The three soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the surface layer is clay loam. In other places the surface is stony or gravelly.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth

of about 60 inches is olive brown, calcareous loam. In some places the surface is stony or gravelly.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the surface layer is less than 7 inches thick and lighter colored. In other places the surface is stony or gravelly. In some areas slope is more than 25 percent.

Included with these soils in mapping are small areas of Hamerly, Parnell, Sioux, and Southam soils. These included soils make up about 5 to 15 percent of the unit. The Hamerly soils are somewhat poorly drained. They are on flats. The Parnell and Southam soils are poorly drained. They are in depressions. The Sioux soils have a substratum of very gravelly sand. They are intermingled with areas of the Buse soil.

Permeability is moderately slow in the Barnes, Svea, and Buse soils. Runoff is very rapid on the Barnes and Buse soils and rapid on the Svea soil. Available water capacity is high in all three soils.

Most areas are used for range. These soils are best suited to this use and to pasture. They generally are unsuited to cultivated crops and to the trees and shrubs grown as windbreaks and environmental plantings because of the slope, the moderate hazard of soil blowing on the Buse soil, and the very severe hazard of water erosion on all three soils.

In areas where these soils are used as range, the important native forage plants are needleandthread, western wheatgrass, green needlegrass, and little bluestem. Smooth bromegrass, big bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

The land capability classification of the Barnes soils is VIe, that of the Svea soil is IVe, and that of the Buse soil is VIIe. The range site of the Barnes and Svea soils is Silty, and that of the Buse soil is Thin Upland. The pasture group of the Barnes and Svea soils is Loamy and Silty, and that of the Buse soil is Thin Upland. The productivity index of the unit for spring wheat is 0.

25E—Barnes-Buse-Parnell complex, 0 to 35 percent slopes. These very deep soils are on moraines. The well drained, nearly level to hilly Barnes soil is on side slopes and foot slopes. The well drained, undulating to steep Buse soil is on summits and shoulder slopes. The very poorly drained, level Parnell soil is in depressions. It is ponded. Individual areas of this unit range from about 20 to more than 1,200 acres in size. They are about 35 to 50 percent Barnes soil, 20 to 35 percent Buse soil, and 15 to 25 percent Parnell soil. The three soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the dark color of the surface layer extends to a depth of more than 16 inches. In other places the surface layer is clay loam. In some areas the surface is stony or gravelly.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, calcareous loam. In some places the surface layer is less than 7 inches thick and lighter colored. In some areas the surface is stony or gravelly.

Typically, the surface soil of the Parnell soil is silty clay loam about 16 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is silty clay about 20 inches thick. It is very dark gray in the upper part and very dark grayish brown in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled loam. In some places the surface layer is silty clay. In other places the soil has a light colored subsurface layer. In a few places the soil is almost continuously ponded.

Included with these soils in mapping are small areas of Hamerly, Sioux, and Vallers soils. These included soils make up about 10 to 15 percent of the unit. The Hamerly and Vallers soils are on flats. The Hamerly soils are somewhat poorly drained. The Vallers soils are poorly drained and saline. The Sioux soils have a substratum of very gravelly sand. They are intermingled with areas of the Buse soil.

Permeability is moderately slow in the Barnes and Buse soils and slow in the Parnell soil. Runoff is very rapid on the Barnes and Buse soils and ponded on the Parnell soil. Available water capacity is high in all three soils. The seasonal high water table is 2 feet above to 2 feet below the surface in the Parnell soil.

Most areas are used for range. These soils are best suited to this use and to pasture. They generally are unsuited to cultivated crops because of the slope, the

very severe hazard of water erosion on the Barnes and Buse soils, and the moderate hazard of soil blowing on the Buse soil.

In areas where these soils are used as range, the important native forage plants are needleandthread, western wheatgrass, green needlegrass, and little bluestem on the Barnes and Buse soils and slough sedge and rivergrass on the Parnell soil. Smooth bromegrass, big bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants on the Barnes and Buse soils. If the Parnell soil is drained, creeping foxtail, reed canarygrass, and alsike clover are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control erosion. Compaction, trampling, and root shearing are problems in areas of the Parnell soil, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

Areas of the Parnell soil and the ponded water provide excellent winter cover for resident wildlife and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are minimizing siltation and maintaining the natural water level.

The Barnes and Buse soils generally are unsuited to machine planting of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs can be grown for esthetic purposes or to enhance wildlife habitat if special management, such as hand or scalp planting, is applied. If drained, the Parnell soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings.

The land capability classification of the Barnes soil is VIe, that of the Buse soil is VIIe, and that of the Parnell soil is IIIw. The range site of the Barnes soil is Silty, that of the Buse soil is Thin Upland, and that of the Parnell soil is Wetland. The pasture group of the Barnes soil is Loamy and Silty, that of the Buse soil is Thin Upland, and that of drained areas of the Parnell soil is Wet. The productivity index of the unit for spring wheat is 0.

30C—Svea-Sioux loams, 3 to 9 percent slopes. These very deep soils are on eskers and breaks between till plains and outwash plains. The well drained, undulating Svea soil is on side slopes. The excessively drained, undulating and gently rolling Sioux soil is on summits and shoulder slopes. Individual areas of this unit range from about 5 to more than 300 acres in size. They are about 35 to 50 percent Svea soil and 30 to 45 percent Sioux soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam. In some places the dark color of the surface layer extends to a depth of only 8 to 15 inches. In other places the substratum below a depth of 40 inches is loamy sand or sand. In some areas the surface soil and subsoil are sandy loam.

Typically, the surface layer of the Sioux soil is black loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand. In some places the subsoil is loam and the depth to gravel is 14 to 20 inches. In other places the surface layer is sandy loam. In some areas it is only 3 to 7 inches thick. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of granitic and shale particles.

Included with these soils in mapping are small areas of Buse, Clontarf, Hamerly, and Tonka soils. These included soils make up about 10 to 20 percent of the unit. The Buse soils have a surface layer and subsoil of calcareous loam. They are intermingled with areas of the Sioux soil. The Clontarf soils have a surface soil and subsoil of fine sandy loam. They are intermingled with areas of the Svea soil. The Hamerly soils are somewhat poorly drained. They are on flats. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately slow in the Svea soil and very rapid in the Sioux soil. Runoff is medium on the Svea soil and slow on the Sioux soil. Available water capacity is high in the Svea soil and low in the Sioux soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate on the Svea soil and slight on the Sioux soil. The hazard of soil blowing is slight on

both soils. Maintaining tilth, overcoming the droughtiness of the Sioux soil, and controlling water erosion are the main management concerns if cultivated crops are grown. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Leaving tall stubble on the surface helps to overcome the droughtiness in areas of the Sioux soil by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Smooth bromegrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control water erosion.

The Svea soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical soil limitations. The Sioux soil generally is unsuited to the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of the Svea soil is IIe, and that of the Sioux soil is VIs. The range site of the Svea soil is Silty, and that of the Sioux soil is Very Shallow. The pasture group of the Svea soil is Loamy and Silty, and that of the Sioux soil is Very Shallow to Gravel. The productivity index of the unit for spring wheat is 50.

30E—Sioux-Barnes loams, 9 to 30 percent slopes. These very deep soils are on eskers and breaks between till plains and outwash plains. The rolling to steep, excessively drained Sioux soil is on summits and shoulder slopes. The rolling to hilly, well drained Barnes soil is on side slopes. Individual areas of this unit range from about 5 to more than 800 acres in size. They are about 40 to 55 percent Sioux soil and 35 to 50 percent Barnes soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Sioux soil is black loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand. In some places the subsoil is loam and the depth to gravel is 14 to 20 inches. In other places the surface layer is sandy loam. In some areas it is only 3 to 7 inches thick. In areas in or near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the dark color of the surface layer extends to a depth of more than 16 inches. In other places the surface layer and subsoil are thinner and lighter colored.

Included with these soils in mapping are small areas of Clontarf, Embden, Fordville, and Southam soils. These included soils make up about 5 to 15 percent of the unit. The Clontarf, Embden, and Fordville soils are on foot slopes. The Clontarf and Embden soils are moderately well drained. The Fordville soils have a substratum of gravelly sand. The Southam soils are very poorly drained. They are in depressions.

Permeability is very rapid in the Sioux soil and moderately slow in the Barnes soil. Runoff is medium on the Sioux soil and very rapid on the Barnes soil. Available water capacity is low in the Sioux soil and high in the Barnes soil.

Most areas are used for range. These soils are best suited to this use. They generally are unsuited to cultivated crops, hay, and pasture and to the trees and shrubs grown as windbreaks and environmental plantings because of the low natural fertility and droughtiness of the Sioux soil and the hazard of erosion on both soils. The hazard of water erosion is moderate on the Sioux soil and very severe on the Barnes soil. The hazard of soil blowing is slight on both soils.

In areas where these soils are used as range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Water erosion is a hazard, especially if the range is overgrazed. Maintaining an adequate cover of the important plants at a height that traps snow increases the moisture supply and helps to control water erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

The land capability classification of the Sioux soil is VIIs, and that of the Barnes soil is VIe. The range site of the Sioux soil is Very Shallow, and that of the Barnes

soil is Silty. The productivity index of the unit for spring wheat is 0.

39F—Kloten-Buse loams, 9 to 50 percent slopes. These strongly sloping to very steep, well drained soils are in stream valleys. The shallow Kloten soil is on valley shoulder slopes and side slopes. The very deep Buse soil is on summits and valley shoulder slopes. Individual areas of this unit range from about 10 to more than 2,000 acres in size. They are about 45 to 65 percent Kloten soil and 35 to 55 percent Buse soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Kloten soil is black loam about 6 inches thick. The next layer is very dark grayish brown loam about 4 inches thick. Below this is shale bedrock. In some places the subsoil is loam and the depth to bedrock is 20 to 40 inches. In other places slope is more than 50 percent.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the surface layer is less than 7 inches thick. In other places the surface is stony or gravelly. In some areas the upper part of the subsoil is brown and noncalcareous. In other areas slope is more than 50 percent.

Included with these soils in mapping are small areas of Darnen, Sioux, and Svea soils. These included soils make up about 5 to 15 percent of the unit. The dark color of the surface layer in the Darnen and Svea soils extends to a depth of more than 16 inches. The Darnen and Svea soils are on foot slopes. The Sioux soils have a substratum of gravelly sand. They are intermingled with areas of the Buse soil.

Permeability is moderate in the Kloten soil and moderately slow in the Buse soil. Runoff is very rapid on both soils. Available water capacity is very low in the Kloten soil and high in the Buse soil.

Most areas are used for range. These soils are best suited to this use. They generally are unsuited to cultivated crops, pasture, and hay and to the trees and shrubs grown as windbreaks and environmental plantings because of the slope, the droughtiness of the Kloten soil, and the hazard of erosion. The hazard of water erosion is very severe on both soils. The hazard of soil blowing is slight on the Kloten soil and moderate on the Buse soil.

In areas where these soils are used as range, the important native forage plants are needleandthread, western wheatgrass, blue grama, and little bluestem. Water erosion and soil blowing are hazards, especially if the range is overgrazed. Maintaining an adequate cover of the important plants at a height that traps snow helps to store water in the soil and control erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of the livestock traffic helps to prevent gullying.

The land capability classification of both soils is VIIe. The range site of the Kloten soil is Shallow, and that of the Buse soil is Thin Upland. The productivity index of the unit for spring wheat is 0.

40—Divide-Marysland loams, 0 to 3 percent slopes. These very deep, highly calcareous soils are on outwash plains. The level and nearly level, somewhat poorly drained Divide soil is on flats. The level, poorly drained Marysland soil is in drainageways, swales, and depressions. Individual areas of this unit range from about 5 to more than 150 acres in size. They are about 50 to 65 percent Divide soil and 20 to 35 percent Marysland soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Divide soil is black, calcareous loam about 10 inches thick. The subsoil is grayish brown, calcareous loam about 12 inches thick. It is mottled in the lower part. The substratum is calcareous. The upper part is olive brown sand and the lower part to a depth of about 60 inches is grayish brown gravelly sand. In some places the layer of sand and gravel in the substratum is at a depth of more than 40 inches. In other places the soil is slightly saline. In a few areas slope is 3 to 6 percent.

Typically, the surface layer of the Marysland soil is black, calcareous loam about 8 inches thick. The subsoil is calcareous. It is about 24 inches thick. It is gray clay loam in the upper part; olive gray, mottled loam in the next part; and light brownish gray, mottled loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, calcareous coarse sand. In some places the layer of sand and gravel in the substratum is at a depth of more than 40 inches.

Included with these soils in mapping are small areas of Colvin, Fordville, and Hamerly soils. These included soils make up about 5 to 15 percent of the unit. The Colvin soils have a substratum of silty clay loam. They are intermingled with areas of the Marysland soil. The Fordville soils are well drained. They are on rises. The Hamerly soils have a subsoil of loam. They are intermingled with areas of the Divide soil. Also included are small areas of a somewhat poorly drained soil that has a sodic subsoil. This included soil is intermingled with areas of the Divide soil.

Permeability is moderate in the upper part of the Divide and Marysland soils and rapid in the lower part.

Runoff is slow. Available water capacity is moderate. The seasonal high water table is at a depth of 2.5 to 5.0 feet in the Divide soil and at a depth of 0 to 2.0 feet in the Marysland soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The main management concerns in cultivated areas are controlling soil blowing, overcoming wetness, and maintaining tilth. Constructing and maintaining surface drains help to reduce the wetness in areas of the Marysland soil. Because locating suitable drainage outlets is difficult, few areas are drained. Drainage can increase the salinity. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are little bluestem, big bluestem, and switchgrass. Smooth bromegrass, big bluestem, reed canarygrass, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing. Compaction, trampling, and root shearing are problems on the Marysland soil if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

The Divide soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical soil limitations. If drained, the Marysland soil is suited to all of the climatically adapted species. Undrained areas generally are unsuited to this use. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Divide soil is IIIs, and that of the Marysland soil is IIw. The range site of the Divide soil is Limy Subirrigated, and that of the Marysland soil is Subirrigated. The pasture group of the Divide soil is Limy Subirrigated, and that of the Marysland soil is Wet. The productivity index of the unit for spring wheat is 57.

41—Fordville-Renshaw loams, 0 to 3 percent slopes. These very deep, level and nearly level soils are on outwash plains and terraces. The well drained Fordville soil is on flats. The somewhat excessively drained Renshaw soil is on rises. Individual areas of this unit range from about 5 to more than 500 acres in size. They are about 45 to 65 percent Fordville soil and 25 to 40 percent Renshaw soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Fordville soil is black loam about 11 inches thick. The subsoil is loam about 16 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The next layer is dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous gravelly sand. In some places the subsoil is mottled. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Typically, the surface layer of the Renshaw soil is black loam about 7 inches thick. The subsoil is very dark grayish brown loam about 8 inches thick. The substratum to a depth of about 60 inches is light olive brown, calcareous gravelly sand. In some places the depth to sand and gravel is less than 14 inches. In other places the surface layer and subsoil are sandy loam. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Included with these soils in mapping are small areas of Darnen, Divide, and Svea soils. These included soils make up about 5 to 20 percent of the unit. The Darnen and Svea soils have a substratum of loam. They are intermingled with areas of the Fordville soil. The Divide soils are somewhat poorly drained. They are in swales.

Permeability is moderate in the upper part of the Fordville and Renshaw soils and rapid in the lower part. Runoff is slow on both soils. Available water capacity is moderate in the Fordville soil and low in the Renshaw soil. Tilth is good.

Most areas are used for cultivated crops. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are maintaining tilth, overcoming the droughtiness, and controlling erosion. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture

conserves moisture and helps to control erosion and maintain or improve tilth. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Smooth bromegrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply.

These soils are suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Because the soils are droughty, the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of the Fordville soil is IIs, and that of the Renshaw soil is IIIs. The range site of the Fordville soil is Silty, and that of the Renshaw soil is Shallow to Gravel. The pasture group of the Fordville soil is Loamy and Silty, and that of the Renshaw soil is Shallow to Gravel. The productivity index of the unit for spring wheat is 57.

41B—Fordville-Renshaw loams, 3 to 6 percent slopes. These very deep, gently sloping soils are on outwash plains. The well drained Fordville soil is on flats and rises. The somewhat excessively drained Renshaw soil is on rises. Individual areas of this unit range from about 5 to more than 500 acres in size. They are about 40 to 60 percent Fordville soil and 35 to 50 percent Renshaw soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Fordville soil is black loam about 11 inches thick. The subsoil is loam about 16 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The next layer is dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous gravelly sand. In some places the substratum is mottled. In other places the dark color of the surface layer extends to a depth of only 8 to 15 inches. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Typically, the surface layer of the Renshaw soil is black loam about 7 inches thick. The subsoil is very dark grayish brown loam about 8 inches thick. The substratum to a depth of about 60 inches is light olive brown, calcareous gravelly sand. In some places the depth to sand and gravel is less than 14 inches. In other places the surface layer and subsoil are sandy loam. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Included with these soils in mapping are small areas of Barnes, Darnen, Divide, and Svea soils. These included soils make up about 5 to 10 percent of the unit. The Barnes, Darnen, and Svea soils have a substratum of loam. They are intermingled with areas of the Fordville soil. The Divide soils are somewhat poorly drained. They are in swales.

Permeability is moderate in the upper part of the Fordville and Renshaw soils and rapid in the lower part. Runoff is slow. Available water capacity is moderate in the Fordville soil and low in the Renshaw soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main management concerns in cultivated areas are maintaining tilth, overcoming the droughtiness, and controlling water erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture conserves moisture and helps to control water erosion and maintain or improve tilth. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Smooth bromegrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or

suitable plants at a height that traps snow increases the moisture supply and helps to control erosion.

These soils are suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. They are droughty, and the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIIe. The range site of the Fordville soil is Silty, and that of the Renshaw soil is Shallow to Gravel. The pasture group of the Fordville soil is Loamy and Silty, and that of the Renshaw soil is Shallow to Gravel. The productivity index of the unit for spring wheat is 46.

44—Arvilla-Sioux sandy loams, 0 to 3 percent slopes. These very deep, level and nearly level soils are on outwash plains. The somewhat excessively drained Arvilla soil is on flats. The excessively drained Sioux soil is on rises. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 50 to 65 percent Arvilla soil and 25 to 35 percent Sioux soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Arvilla soil is black sandy loam about 8 inches thick. The subsoil is very dark grayish brown sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is dark brown, calcareous gravelly sand. In some places the surface layer and subsoil are loam. In other places the substratum has less than 5 percent gravel. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Typically, the surface layer of the Sioux soil is black sandy loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand. In some places the surface layer is loam. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Included with these soils in mapping are small areas of Divide and Fordville soils. These included soils make up about 5 to 15 percent of the unit. The Divide soils are somewhat poorly drained. They are in drainageways. The Fordville soils have a surface soil and subsoil of loam. They are in swales.

Permeability is moderately rapid in the upper part of the Arvilla soil and very rapid in the lower part. It is very rapid in the Sioux soil. Runoff is very slow on both soils. Available water capacity is low. Tilth is good.

Most areas are used for cultivated crops or for range. These soils are best suited to range and pasture. They are poorly suited to cultivated crops. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are overcoming the droughtiness and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture conserves moisture and helps to control soil blowing. Leaving tall stubble on the surface also helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, little bluestem, and blue grama. Crested wheatgrass, western wheatgrass, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing.

The Arvilla soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Sioux soil generally is unsuited to the climatically adapted species. The Arvilla soil is droughty, and the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Arvilla soil is IIIe, and that of the Sioux soil is VIs. The range site of the Arvilla soil is Shallow to Gravel, and that of the

Sioux soil is Very Shallow. The pasture group of the Arvilla soil is Shallow to Gravel, and that of the Sioux soil is Very Shallow to Gravel. The productivity index of the unit for spring wheat is 34.

44C—Sioux-Arvilla sandy loams, 1 to 9 percent slopes. These very deep, nearly level to gently rolling soils are on outwash plains. The excessively drained Sioux soil is on rises and ridges. The somewhat excessively drained Arvilla soil is on flats and rises. Individual areas of this unit range from about 5 to more than 2,500 acres in size. They are about 60 to 70 percent Sioux soil and 20 to 30 percent Arvilla soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Sioux soil is black sandy loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand. In some places the surface layer is loam or loamy sand. In other places it is only 3 to 6 inches thick. In some areas the substratum has less than 5 percent gravel. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Typically, the surface layer of the Arvilla soil is black sandy loam about 8 inches thick. The subsoil is very dark grayish brown sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is dark brown, calcareous gravelly sand. In some places the surface layer and subsoil are loam. In other places the substratum has less than 5 percent gravel. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Included with these soils in mapping are small areas of Divide, Embden, Fordville, Maddock, and Svea soils. These included soils make up about 10 to 15 percent of the unit. The Divide soils are somewhat poorly drained. They are in drainageways. The Embden, Svea, and Fordville soils are in swales. The Embden and Svea soils are moderately well drained. The Fordville soils are loam to a depth of 20 to 40 inches. The well drained Maddock soils have a surface layer and subsoil of loamy fine sand. They are intermingled with areas of the Sioux soil.

Permeability is very rapid in the Sioux soil. It is moderately rapid in the upper part of the Arvilla soil and very rapid in the lower part. Runoff is slow on both soils. Available water capacity is low. Tilth is good.

Most areas are used for cultivated crops or for range. These soils are best suited to range and pasture. They are generally unsuited to cultivated crops because of the droughtiness, the low natural fertility in areas of the Sioux soil, and the hazard of soil blowing. The hazard of water erosion is slight, and the hazard of soil blowing is severe. Establishing a cover of grasses and legumes in cultivated areas helps to control erosion and maintain productivity.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Crested wheatgrass, western wheatgrass, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing.

The Sioux soil generally is unsuited to the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Arvilla soil is suited to some of the climatically adapted species. Because it is droughty, the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Sioux soil is VIs, and that of the Arvilla soil is IVe. The range site of the Sioux soil is Very Shallow, and that of the Arvilla soil is Shallow to Gravel. The pasture group of the Sioux soil is Very Shallow to Gravel, and that of the Arvilla soil is Shallow to Gravel. The productivity index of the unit for spring wheat is 0.

44E—Sioux-Arvilla sandy loams, 9 to 35 percent slopes. These very deep soils are on outwash plains. The excessively drained, rolling to steep Sioux soil is on ridges. The somewhat excessively drained, rolling and hilly Arvilla soil is on side slopes. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 55 to 70 percent Sioux soil and 20 to 35 percent Arvilla soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Sioux soil is black sandy loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand. In some

places the surface layer is loamy sand. In other places it is only 3 to 6 inches thick. In some areas the substratum has less than 5 percent gravel. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Typically, the surface layer of the Arvilla soil is black sandy loam about 8 inches thick. The subsoil is very dark grayish brown sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is dark brown, calcareous gravelly sand. In some places the surface layer and subsoil are loam. In other places the substratum has less than 5 percent gravel. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Included with these soils in mapping are small areas of Buse, Divide, Embden, Fordville, and Maddock soils. These included soils make up about 5 to 15 percent of the unit. The Buse and Maddock soils are well drained. They are intermingled with areas of the Sioux soil. The Divide soils are somewhat poorly drained. They are in drainageways. The Embden and Fordville soils are on foot slopes. The Embden soils are moderately well drained. The Fordville soils are loam to a depth of 20 to 40 inches. Also included are some areas that have a slope of more than 30 percent.

Permeability is very rapid in the Sioux soil. It is moderately rapid in the upper part of the Arvilla soil and very rapid in the lower part. Runoff is medium on both soils. Available water capacity is low.

Most areas are used for range. These soils are best suited to this use. They generally are unsuited to cultivated crops, pasture, and hay and to the trees and shrubs grown as windbreaks and environmental plantings because of the low natural fertility, droughtiness, the slope, and the hazard of erosion. The hazard of water erosion is moderate, and the hazard of soil blowing is severe.

In areas where these soils are used as range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Water erosion and soil blowing are hazards, especially if the range is overgrazed. Maintaining an adequate cover of the important plants at a height that traps snow increases the moisture supply and helps to control erosion. Gullies can form along cattle trails. A planned grazing system that controls that pattern of livestock traffic helps to prevent gullying.

The land capability classification of the Sioux soil is VIIs, and that of the Arvilla soil is VIe. The range site of the Sioux soil is Very Shallow, and that of the Arvilla soil is Shallow to Gravel. The productivity index of the unit for spring wheat is 0.

47B—Renshaw-Sioux loams, 0 to 6 percent slopes. These very deep, level to undulating soils are on outwash plains and terraces. The somewhat excessively drained Renshaw soil is on flats and rises. The excessively drained Sioux soil is on rises and ridges. Individual areas of this unit range from about 5 to more than 400 acres in size. They are about 45 to 60 percent Renshaw soil and 25 to 40 percent Sioux soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Renshaw soil is black loam about 7 inches thick. The subsoil is very dark grayish brown loam about 8 inches thick. The substratum to a depth of about 60 inches is light olive brown, calcareous gravelly sand. In some places the surface layer and subsoil are sandy loam. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Typically, the surface layer of the Sioux soil is black loam about 7 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, calcareous very gravelly sand. In areas in and near the James River Valley, the substratum of sand and gravel is a mixture of hard granitic and soft shale particles.

Included with these soils in mapping are small areas of Barnes, Divide, and Fordville soils. These included soils make up about 10 to 20 percent of the unit. The well drained Barnes soils are loam throughout the profile. They are intermingled with areas of the Renshaw soil. The Divide soils are somewhat poorly drained. They are on flats. The dark color of the surface soil in the Fordville soils extends to a depth of more than 16 inches. These soils are in swales.

Permeability is moderate in the upper part of the Renshaw soil and rapid in the lower part. It is very rapid in the Sioux soil. Runoff is slow on the Renshaw soil and very slow on the Sioux soil. Available water capacity is low in both soils. Tilth is good.

Most areas are used for cultivated crops or for range. Some areas are used for hay. These soils are best suited to range and pasture. They are poorly suited to cultivated crops. The hazard of water erosion is moderate on the Renshaw soil and slight on the Sioux soil. The hazard of soil blowing is slight on both soils. The main management concerns in cultivated areas are maintaining tilth, overcoming the droughtiness, and controlling water erosion. Grassed waterways are needed in areas where water concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture conserves moisture and helps to control

water erosion and maintain or improve tilth. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, and little bluestem. Crested wheatgrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control erosion.

The Renshaw soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Sioux soil generally is unsuited to the climatically adapted species. Because the Renshaw soil is droughty, the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of the Renshaw soil is IIIe, and that of the Sioux soil is VIs. The range site of the Renshaw soil is Shallow to Gravel, and that of the Sioux soil is Very Shallow. The pasture group of the Renshaw soil is Shallow to Gravel, and that of the Sioux soil is Very Shallow. The productivity index of the unit for spring wheat is 36.

48B—Maddock loamy fine sand, 0 to 6 percent slopes. This very deep, level to undulating, well drained soil is on flats and rises on outwash plains. Individual areas range from about 5 to more than 120 acres in size.

Typically, the surface soil is very dark brown loamy fine sand about 15 inches thick. The subsoil is dark grayish brown loamy fine sand about 17 inches thick. The substratum to a depth of about 60 inches is brown, calcareous fine sand. In some places the surface layer is fine sandy loam. In other places, the soil has no subsoil and the lower part of the substratum is mottled.

Included with this soil in mapping are small areas of Arveson, Arvilla, and Clontarf soils. These soils make up about 5 to 10 percent of the unit. The Arveson soils are poorly drained. They are in depressions. The Arvilla and Clontarf soils are intermingled with areas of the Maddock soil. The Arvilla soils are somewhat excessively drained. The Clontarf soils have a surface soil and subsoil of fine sandy loam.

Permeability is rapid in the Maddock soil, and runoff is very slow. Available water capacity is low. Tilth is good.

Most areas are used for cultivated crops or range. Some areas are used for hay or pasture. This soil is best suited to range and pasture. It is poorly suited to cultivated crops. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are overcoming the droughtiness and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture conserves moisture and helps to control soil blowing. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are prairie sandreed and needleandthread. Green needlegrass, sand bluestem, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Because the soil is somewhat droughty, the trees and shrubs commonly are affected by moisture stress, particularly during the establishment period. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IVe. The range site and pasture group are Sands. The productivity index for spring wheat is 42.

48D—Maddock loamy fine sand, 6 to 15 percent slopes. This very deep, gently rolling and rolling, well drained soil is on the ridges of outwash plains. Individual areas range from about 5 to more than 50 acres in size.

Typically, the surface soil is very dark brown loamy fine sand about 15 inches thick. The subsoil is dark grayish brown loamy fine sand about 17 inches thick. The substratum to a depth of about 60 inches is brown, calcareous fine sand. In some places the surface layer is eroded and is only a few inches thick. In other places it is sandy loam. In some areas, the soil has no subsoil and the lower part of the substratum is mottled.

Included with this soil in mapping are small areas of Arvilla, Clontarf, Embden, and Sioux soils. These soils make up about 10 to 20 percent of the unit. The Arvilla and Sioux soils are intermingled with areas of the Maddock soil. The Arvilla soils are somewhat excessively drained. The Sioux soils are excessively drained. The Clontarf and Embden soils are on foot slopes. The Clontarf soils have a surface soil and subsoil of fine sandy loam. The Embden soils are moderately well drained.

Permeability is rapid in the Maddock soil, and runoff is slow. Available water capacity is low.

Most areas are used for range. This soil is best suited to range and pasture. It generally is unsuited to cultivated crops and to the trees and shrubs grown as windbreaks and environmental plantings because of the slope, droughtiness, the low natural fertility, and the hazard of erosion. The hazard of water erosion is slight, and the hazard of soil blowing is severe.

In areas where this soil is used as range, the important native forage plants are prairie sandreed and needleandthread. Sand bluestem, prairie sandreed, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing. Gullies can form along cattle trails. Denuding can also occur along the cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying and denuding.

The land capability classification is VIe. The range site and pasture group are Sands. The productivity index for spring wheat is 0.

49—Wyndmere fine sandy loam, 0 to 3 percent slopes. This very deep, level and nearly level, somewhat poorly drained, highly calcareous soil is in swales on lake plains and outwash plains. Individual areas range from about 5 to more than 100 acres in size.

Typically, the surface layer is very dark gray, calcareous fine sandy loam about 9 inches thick. The next layer is very dark grayish brown, calcareous fine sandy loam about 6 inches thick. The subsoil is dark grayish brown and light olive brown, calcareous fine sandy loam about 17 inches thick. The substratum is calcareous. The upper part is light olive brown, mottled loamy fine sand and the lower part to a depth of about 60 inches is grayish brown, mottled, stratified loam and silt loam.

Included with this soil in mapping are small areas of Embden, Fossum, Hecla, and Swenoda soils. These soils make up about 10 to 30 percent of the unit. They do not have an accumulation of lime within a depth of 16 inches. The Embden, Hecla, and Swenoda soils are on rises. The Fossum soils are in shallow depressions. Also included in mapping are small areas of a somewhat poorly drained soil that has a dense, sodic subsoil. This soil is intermingled with areas of the Wyndmere soil.

Permeability is moderately rapid in the upper part of the Wyndmere soil and moderately slow in the lower part. Runoff is slow. Available water capacity is moderate. The seasonal high water table is at a depth of 2 to 5 feet. Tilth is fair.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concern in cultivated areas is controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are little bluestem, big bluestem, and switchgrass. Big bluestem, smooth bromegrass, intermediate wheatgrass, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of

an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIIe. The range site and pasture group are Limy Subirrigated. The productivity index for spring wheat is 67.

50—Fossum fine sandy loam. This very deep, level, poorly drained, calcareous soil is in shallow depressions on lake plains and outwash plains. Individual areas range from about 5 to more than 40 acres in size.

Typically, the surface soil is black and calcareous. It is about 17 inches thick. It is fine sandy loam in the upper part and loamy fine sand in the lower part. The subsoil is grayish brown, mottled, calcareous fine sand about 13 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, calcareous fine sand.

Included with this soil in mapping are small areas of Hecla, Ulen, and Wyndmere soils. These soils make up about 10 to 30 percent of the unit. The Hecla soils are moderately well drained. They are on rises. The Ulen and Wyndmere soils are somewhat poorly drained. They are on flats adjacent to depressions. Also included are small areas of Fossum soils that are ponded. These soils are in the deepest part of the depressions.

Permeability is rapid in the Fossum soil, and runoff is very slow. Available water capacity is low. The seasonal high water table is at a depth of 1.0 to 2.5 feet. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. If drained, this soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay. Undrained areas are best suited to hay or range. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are controlling wetness and soil blowing. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage and cultivation can increase the salinity. Applying a system of conservation tillage that leaves crop residue on the surface and establishing windbreaks help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem and switchgrass. Big bluestem, reed canarygrass, switchgrass, and alsike clover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIIw. The range site is Subirrigated. The pasture group is Wet. The productivity index for spring wheat ranges from 20 to 60, depending on the degree of drainage.

51—Arveson loam, saline. This very deep, level, poorly drained, highly calcareous, moderately saline soil is on flats and in depressions on lake plains. Some areas are dissected by meandering channels. Individual areas range from about 5 to more than 50 acres in size.

Typically, the surface soil is black, calcareous loam about 10 inches thick. The subsoil is gray, calcareous loam about 14 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is gray, mottled, calcareous fine sandy loam. In some places the soil is slightly saline.

Included with this soil in mapping are small areas of Colvin, Divide, Hamerly, and Ulen soils. These soils make up about 5 to 15 percent of the unit. The saline Colvin soils are silty clay loam throughout the profile. They are in drainageways. The Divide, Hamerly, and Ulen soils are somewhat poorly drained. They are on rises.

Permeability is moderate in the Arveson soil, and runoff is very slow. Available water capacity is low. The seasonal high water table is within a depth of 2 feet. Tilth is fair. The salinity restricts the growth of plants.

Most areas are used for pasture or hay, but some areas are used for range. This soil is best suited to these uses. It is poorly suited to cultivated crops. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The main management concerns in cultivated areas are overcoming the wetness and salinity and controlling the soil blowing. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage can increase the salinity. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and minimize surface salinity. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Planting salt-tolerant crops, avoiding the use of summer fallow,

and shallow tillage also help to overcome salinity.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, Nuttall alkaligrass, and inland saltgrass. Tall wheatgrass, western wheatgrass, and alsike clover are suitable hay and pasture plants. Soil blowing is a hazard. The high content of salt and the reduced amount of available water are problems, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing, minimize surface salinity, and store water in the soil. Compaction, trampling, and root shearing are problems if the range or pasture is grazed when wet. Grazing should be deferred during wet periods. Stock water ponds constructed in areas of this soil frequently contain salty water.

This soil is suited to only a few of the most salt-tolerant climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs vary in height, density, and vigor, which are affected by the reduced amount of available water caused by the salts in the soil. Reducing the evaporation rate at the surface improves seedling survival. When the bare surface of the soil dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification IIIs. The range site is Saline Lowland. The pasture group is Saline. The productivity index for spring wheat is 21.

52—Hecla-Ulen complex, 0 to 3 percent slopes. These very deep, level and nearly level soils are on outwash plains and lake plains. The moderately well drained Hecla soil is on rises. The somewhat poorly drained, highly calcareous Ulen soil is in swales. Individual areas of this unit range from about 5 to more than 400 acres in size. They are about 75 to 85 percent Hecla soil and 5 to 20 percent Ulen soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Hecla soil is black loamy fine sand about 17 inches thick. The next layer is very dark grayish brown loamy sand about 6 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, mottled loamy sand. In some places the substratum is not mottled.

Typically, the surface layer of the Ulen soil is black, calcareous fine sandy loam about 7 inches thick. The subsoil is calcareous fine sandy loam about 15 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is light olive gray, calcareous loamy fine sand. In some places the soil has less sand. In other places the subsoil and substratum are mottled.

Included with these soils in mapping are small areas of Arveson, Clontarf, and Towner soils. These included soils make up about 5 to 15 percent of the unit. The Arveson soils are poorly drained and saline. They are in depressions. The Clontarf and Towner soils are on rises. The Clontarf soils have a surface soil and subsoil of fine sandy loam. The Towner soils have a substratum of loam. Also included are small areas of a somewhat poorly drained soil that has a sodic subsoil. This included soil is intermingled with areas of the Ulen soil.

Permeability is rapid in the Hecla and Ulen soils. Runoff is very slow. Available water capacity is low in the Hecla soil and moderate in the Ulen soil. The seasonal high water table is at a depth of 3.0 to 6.0 feet in the Hecla soil and at a depth of 2.5 to 6.0 feet in the Ulen soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, barley, and flax and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are overcoming the droughtiness and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture conserves moisture and helps to control soil blowing. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are prairie sandreed, little bluestem, and needleandthread. Green needlegrass, sand bluestem, big bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

These soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and

shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Hecla soil is IVe, and that of the Ulen soil is IIIe. The range site and pasture group of the Hecla soil are Sands, and those of the Ulen soils are Limy Subirrigated. The productivity index of the unit for spring wheat is 51.

54B—Hecla-Towner loamy fine sands, 1 to 6 percent slopes. These very deep, nearly level and undulating, moderately well drained soils are on mantled till plains and outwash plains. The Hecla soil is in swales. The Towner soil is on rises. Individual areas of this unit range from about 5 to more than 300 acres in size. They are about 40 to 60 percent Hecla soil and 25 to 45 percent Towner soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Hecla soil is black loamy fine sand about 17 inches thick. The next layer is very dark grayish brown loamy sand about 6 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, mottled loamy sand. In some places the substratum is not mottled. In other places the surface soil and the next layer are fine sandy loam.

Typically, the surface soil of the Towner soil is about 20 inches thick. It is black loamy fine sand in the upper part and very dark grayish brown loamy sand in the lower part. The subsoil is about 21 inches thick. It is dark brown, mottled loamy sand in the upper part and olive brown, mottled, calcareous loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the dark color of the surface soil extends to a depth of only 7 to 15 inches. In other places the layer of loam in the subsoil is at a depth of more than 40 inches. In some areas the substratum is silt loam or silty clay loam.

Included with these soils in mapping are small areas of Buse, Fossum, Swenoda, and Ulen soils. These included soils make up about 10 to 20 percent of the unit. The Buse soils are well drained. They are on knolls. The Fossum soils are poorly drained. They are in depressions. The Swenoda soils have a surface soil of fine sandy loam. They are intermingled with areas of the Hecla soil. The Ulen soils are somewhat poorly drained. They are on flats.

Permeability is rapid in the Hecla soil. It is rapid in the upper part of the Towner soil and moderately slow in the lower part. Runoff is very slow on both soils. Available water capacity is low in the Hecla soil and moderate in the Towner soil. The seasonal high water table is at a depth of 3 to 6 feet in both soils. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are overcoming the droughtiness and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture conserves moisture and helps to control soil blowing. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are prairie sandreed and needleandthread. Green needlegrass, sand bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

The Hecla soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Towner soil is suited to many of the climatically adapted species. Because it is somewhat droughty, the trees and shrubs commonly are affected by moisture stress, particularly during the establishment period. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of both soils is IVe. The range site and pasture group are Sands. The productivity index of the unit for spring wheat is 53.

55—Towner loamy fine sand, 0 to 3 percent slopes. This very deep, level and nearly level, moderately well drained soil is in swales on mantled till plains. Individual areas range from about 5 to more than 500 acres in size.

Typically, the surface soil is about 20 inches thick. It

is black loamy fine sand in the upper part and very dark grayish brown loamy sand in the lower part. The subsoil is mottled. It is about 21 inches thick. It is dark brown loamy sand in the upper part and olive brown, calcareous loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the layer of loam in the subsoil is at a depth of more than 40 inches. In other places the substratum is silt loam or silty clay loam.

Included with this soil in mapping are small areas of Barnes, Fossum, Hecla, and Swenoda soils. These soils make up about 5 to 15 percent of the unit. The Barnes soils are well drained. They are on rises. The Fossum soils are poorly drained. They are in depressions. The Hecla and Swenoda soils are intermingled with areas of the Towner soil. The Hecla soils have a substratum of loamy sand. The Swenoda soils are fine sandy loam to a depth of more than 20 inches.

Permeability is rapid in the upper part of the Towner soil and moderately slow in the lower part. Runoff is very slow. Available water capacity is moderate. The seasonal high water table is at a depth of 3 to 6 feet. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are overcoming the droughtiness and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture conserves moisture and helps to control soil blowing. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are prairie sandreed and needleandthread. Green needlegrass, sand bluestem, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard and droughtiness is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Because the soil is somewhat droughty, the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the moderate available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IVe. The range site and pasture group are Sands. The productivity index for spring wheat is 55.

56—Swenoda fine sandy loam, 0 to 3 percent slopes. This very deep, level and nearly level, moderately well drained soil is in swales on mantled till plains. Individual areas range from about 5 to more than 600 acres in size.

Typically, the surface soil is fine sandy loam about 11 inches thick. It is black in the upper part and very dark brown in the lower part. The subsoil is about 32 inches thick. It is very dark brown fine sandy loam in the upper part, dark brown fine sandy loam in the next part, and grayish brown, calcareous loam in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the layer of loam in the subsoil is at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Barnes, Larson, Maddock, Tonka, and Wyndmere soils. These soils make up about 10 to 25 percent of the unit. The Barnes and Maddock soils are well drained. They are on rises. The Larson and Wyndmere soils are somewhat poorly drained. They are on flats. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderately slow in the lower part. Runoff is slow. Available water capacity is high. The seasonal high water table is at a depth of 2.5 to 4.0 feet. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are maintaining tilth and controlling soil blowing. Applying a system of conservation tillage that leaves

crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are prairie sandreed and needleandthread. Green needlegrass, sand bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIIe. The range site and pasture group are Sandy. The productivity index for spring wheat is 75.

56B—Swenoda-Buse complex, 3 to 6 percent slopes. These very deep, undulating soils are on till plains. The moderately well drained Swenoda soil is in swales. It has a mantle of sand overlying the till. The well drained Buse soil is on rises. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 65 to 80 percent Swenoda soil and 10 to 25 percent Buse soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Swenoda soil is fine sandy loam about 11 inches thick. It is black in the upper part and very dark brown in the lower part. The subsoil is about 32 inches thick. It is very dark brown fine sandy loam in the upper part, dark brown fine sandy loam in the next part, and grayish brown, calcareous loam in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the surface layer and subsoil are thinner and lighter colored. In other places the soil is fine sandy loam to a depth of more than 40 inches.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the upper part of the subsoil is brown and noncalcareous. In other places the surface layer is sandy loam.

Included with these soils in mapping are small areas of Larson, Maddock, Tonka, Towner, and Wyndmere soils. These included soils make up about 5 to 20 percent of the unit. The Larson and Wyndmere soils are somewhat poorly drained. They are on flats. The Maddock and Towner soils are intermingled with areas of the Swenoda soil. The Maddock soils have a substratum of fine sand. The Towner soils have a surface soil of loamy fine sand. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderately slow in the lower part. It is moderately slow in the Buse soil. Runoff is slow on the Swenoda soil and medium on the Buse soil. Available water capacity is high in both soils. The seasonal high water table is at a depth of 2.5 to 4.0 feet in the Swenoda soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight on the Swenoda soil and moderate on the Buse soil. The hazard of soil blowing is severe on the Swenoda soil and moderate on the Buse soil. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are prairie sandreed, little bluestem, and needleandthread. Green needlegrass, sand bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control erosion. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

The Swenoda soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Buse soil is suited to only

the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on this soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of both soils is IIIe. The range site and pasture group of the Swenoda soil are Sandy, and those of the Buse soil are Thin Upland. The productivity index of the unit for spring wheat is 63.

56C—Swenoda-Buse complex, 6 to 9 percent slopes. These very deep, gently rolling, well drained soils are on till plains. The Swenoda soil is on side slopes and foot slopes. It has a mantle of sand overlying the till. The Buse soil is on summits and shoulder slopes. Individual areas of this unit range from about 5 to more than 200 acres in size. They are about 50 to 65 percent Swenoda soil and 30 to 45 percent Buse soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Swenoda soil is fine sandy loam about 11 inches thick. It is black in the upper part and very dark brown in the lower part. The subsoil is about 32 inches thick. It is very dark brown fine sandy loam in the upper part, dark brown fine sandy loam in the next part, and grayish brown, calcareous loam in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the soil is fine sandy loam to a depth of more than 40 inches. In other places slope is 9 to 12 percent.

Typically, the surface layer of the Buse soil is black loam about 7 inches thick. The subsoil is calcareous loam about 29 inches thick. It is dark grayish brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the upper part of the subsoil is brown and noncalcareous. In other places slope is 9 to 12 percent.

Included with these soils in mapping are small areas of Hamerly, Hecla, Parnell, Svea, and Towner soils. These included soils make up about 5 to 15 percent of the unit. The Hamerly soils are somewhat poorly drained. They are on flats. The Hecla, Svea, and Towner soils are intermingled with areas of the Swenoda soil. The Hecla and Towner soils have a surface soil of loamy fine sand. The Svea soils are loam throughout the profile. The Parnell soils are very poorly drained. They are in depressions.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderately slow in the lower part. It is moderately slow in the Buse soil. Runoff is medium on the Swenoda soil and rapid on the Buse soil. Available water capacity is high in both soils. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate on the Swenoda soil and severe on the Buse soil. The hazard of soil blowing is severe on the Swenoda soil and moderate on the Buse soil. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are prairie sandreed, little bluestem, and needleandthread. Green needlegrass, sand bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control erosion. Gullies can form along cattle trails. Denuding can also occur along the cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying and denuding.

The Swenoda soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Buse soil is suited to only the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on this soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of both soils is IVe. The range site and pasture group of the Swenoda soil are Sandy, and those of the Buse soil are Thin Upland. The productivity index of the unit for spring wheat is 47.

57B—Embden fine sandy loam, 0 to 6 percent slopes. This very deep, level to gently sloping, moderately well drained soil is in swales and on rises

on lake plains and outwash plains. Individual areas range from about 5 to more than 100 acres in size.

Typically, the surface soil is fine sandy loam about 18 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is fine sandy loam about 14 inches thick. It is very dark grayish brown in the upper part and dark brown in the lower part. The substratum to a depth of about 60 inches is fine sandy loam. It is dark brown in the upper part and dark yellowish brown and calcareous in the lower part. In some areas the dark colors of the surface layer extend only to a depth of 8 to 15 inches. In some places the substratum is sand or loamy sand. In other places it is loam below a depth of 40 inches.

Included with this soil in mapping are small areas of Fossum, Hecla, and Wyndmere soils. These soils make up about 10 to 20 percent of the unit. The Fossum soils are poorly drained. They are in depressions. The Hecla soils have a surface soil of loamy fine sand and a substratum of loamy sand. They are intermingled with areas of the Embden soil. The Wyndmere soils are somewhat poorly drained. They are on flats. Also included are small areas of well drained soils that are silt loam throughout the profile. They are on rises.

Permeability is moderately rapid in the Embden soil, and runoff is slow. Available water capacity is moderate. The seasonal high water table is at a depth of 4 to 6 feet. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are maintaining tilth and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are prairie sandreed and needleandthread. Green needlegrass, sand bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIIe. The range site and pasture group are Sandy. The productivity index for spring wheat is 65.

58B—Clontarf fine sandy loam, 0 to 6 percent slopes. This very deep, level to gently sloping, well drained soil is on flats and rises on outwash plains. Individual areas range from about 5 to more than 400 acres in size.

Typically, the surface soil is black fine sandy loam about 17 inches thick. The subsoil is very dark grayish brown fine sandy loam about 8 inches thick. The next layer is dark brown loamy sand about 6 inches thick. The substratum to a depth of about 60 inches is olive brown and mottled. It is sand in the upper part and calcareous fine sand in the lower part. In some places the substratum is coarse sand and has as much as 15 percent gravel. In other places the soil is fine sandy loam to a depth of more than 40 inches.

Included with this soil in mapping are small areas of Arveson, Fordville, and Maddock soils. These soils make up about 5 to 15 percent of the unit. The Arveson soils are poorly drained. They are in depressions and drainageways. The Fordville and Maddock soils are intermingled with areas of the Clontarf soil. The Fordville soils have a subsoil of loam. The Maddock soils have a surface soil and subsoil of loamy fine sand.

Permeability is moderately rapid in the Clontarf soil, and runoff is slow. Available water capacity is moderate. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are maintaining tilth, overcoming the droughtiness, and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are prairie sandreed and needleandthread. Green needlegrass, sand bluestem, western wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard and droughtiness is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control soil blowing. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Because the soil is somewhat droughty, the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing during the season prior to planting because of the moderate available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIIe. The range site and pasture group are Sandy. The productivity index for spring wheat is 56.

60—Hamerly-Cresbard loams, 0 to 3 percent slopes. These very deep, level and nearly level soils are on till plains. The somewhat poorly drained, highly calcareous Hamerly soil is on flats. The moderately well drained, sodic Cresbard soil is on rises. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 35 to 50 percent Hamerly soil and 30 to 45 percent Cresbard soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Hamerly soil is black, calcareous loam about 9 inches thick. The subsoil is light olive brown, calcareous loam about 19 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the soil is slightly saline. In other places the substratum is gray.

Typically, the surface layer of the Cresbard soil is black loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 2 inches thick. The next layer is very dark grayish brown clay loam about 5 inches thick. The subsoil is dense. It is about 14 inches thick. It is very dark grayish brown clay loam in the upper part, dark grayish brown clay loam in the next part, and light brownish gray, calcareous loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the subsoil is very dense. In other places it has less clay.

Included with these soils in mapping are small areas of Miranda, Parnell, Svea, and Tonka soils. These included soils make up about 10 to 15 percent of the unit. The Miranda soils have salts within a depth of 16 inches. They are intermingled with areas of the Hamerly soil. The Parnell and Tonka soils are in depressions. The Parnell soils are very poorly drained. The Tonka soils are poorly drained. The Svea soils do not have a sodic subsoil. They are intermingled with areas of the Cresbard soil.

Permeability is moderately slow in the Hamerly soil and slow in the Cresbard soil. Runoff is slow on both soils. Available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet in the Hamerly soil and at a depth of 4 to 6 feet in the Cresbard soil. Tilth is fair. The dense, sodic subsoil of the Cresbard soil restricts the rooting depth of plants.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight. The hazard of soil blowing is moderate on the Hamerly soil and slight on the Cresbard soil. The main management concerns in cultivated areas are maintaining tilth and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Because of moisture stress in most years, crop growth on the Cresbard soil is uneven, especially as the crop nears maturity. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. Timely tillage and additions of organic material improve tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, improves root penetration in the dense subsoil of the Cresbard soil. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are little bluestem, big bluestem, green needlegrass, and western wheatgrass. Smooth bromegrass, green needlegrass, big bluestem, and sweetclover are suitable hay and pasture plants. The soil blowing in areas of the Hamerly soil is a hazard, especially if the range or pasture is overgrazed.

Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

The Hamerly soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cresbard soil is suited to many of the climatically adapted species. Individual trees and shrubs growing on the Cresbard soil vary in height, density, and vigor, which are affected by the restricted root development in the dense subsoil and the reduced amount of available water caused by the salts in the soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Hamerly soil is IIe, and that of the Cresbard soil is IIIs. The range site of the Hamerly soil is Limy Subirrigated, and that of the Cresbard soil is Clayey. The pasture group of the Hamerly soil is Limy Subirrigated, and that of the Cresbard soil is Clayey Subsoil. The productivity index of the unit for spring wheat is 77.

61B—Swenoda-Larson fine sandy loams, 1 to 6 percent slopes. These very deep, nearly level and undulating soils are on mantled till plains. The moderately well drained Swenoda soil is on rises. The somewhat poorly drained, sodic Larson soil is in swales. Individual areas of this unit range from about 5 to more than 300 acres in size. They are about 40 to 55 percent Swenoda soil and 30 to 45 percent Larson soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Swenoda soil is fine sandy loam about 11 inches thick. It is black in the upper part and very dark brown in the lower part. The subsoil is about 32 inches thick. It is very dark brown fine sandy loam in the upper part, dark brown fine sandy loam in the next part, and grayish brown, calcareous loam in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled, calcareous loam. In some places the lower part of the subsoil and the substratum are loamy sand or sand. In other places they are fine sandy loam to a depth of more than 40 inches.

Typically, the surface layer of the Larson soil is black fine sandy loam about 6 inches thick. The subsurface layer is very dark grayish brown and dark brown fine sandy loam about 2 inches thick. The subsoil is dense. It is about 27 inches thick. It is dark brown clay loam in the upper part, dark grayish brown loam in the next part, and light brownish gray, calcareous loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the subsoil is fine sandy loam. In other places it is very dense.

Included with these soils in mapping are small areas of Buse, Svea, Tonka, and Wyndmere soils. These included soils make up about 5 to 20 percent of the unit. The Buse soils are well drained. They are on knolls. The Svea soils have a surface layer and subsoil of loam. They are intermingled with areas of the Swenoda soil. The Tonka soils are poorly drained. They are in depressions. The Wyndmere soils are somewhat poorly drained and do not have a sodic subsoil. They are on flats.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderately slow in the lower part. It is slow in the upper part of the Larson soil and moderate in the lower part. Runoff is slow on the Swenoda soil and medium on the Larson soil. Available water capacity is high in the Swenoda soil and moderate in the Larson soil. The seasonal high water table is at a depth of 2.5 to 4.0 feet in the Swenoda soil and at a depth of 3.0 to 6.0 feet in the Larson soil. Tilth is fair. The dense, sodic subsoil of the Larson soil restricts the rooting depth of plants.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight on the Swenoda soil and moderate on the Larson soil. The hazard of soil blowing is severe. The main management concerns in cultivated areas are controlling erosion and maintaining tilth in areas of the Larson soil. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Because of moisture stress in most years, crop growth on the Larson soil is uneven, especially as the crop nears maturity. The surface tends to puddle when wet and becomes hard and forms clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. Timely tillage and additions of organic material improve tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, improves root penetration in the dense subsoil of the Larson soil. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are prairie sandreed, needleandthread, and western wheatgrass. Green needlegrass, western wheatgrass, sweetclover, and alfalfa are suitable hay and pasture plants. Water

erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants at a height that traps snow increases the moisture supply and helps to control erosion. Denuding can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent denuding.

The Swenoda soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Larson soil is suited to only a few of the most salt-tolerant climatically adapted species. Individual trees and shrubs growing on the Larson soil vary in height, density, and vigor, which are affected by the reduced amount of available water caused by the salts in the soil. Reducing the evaporation rate at the surface improves seedling survival. When the bare surface dries, salt-laden water tends to move to the surface. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Swenoda soil is IIIe, and that of the Larson soil is IVs. The range site and pasture group of the Swenoda soil are Sandy, and those of the Larson soil are Claypan. The productivity index of the unit for spring wheat is 58.

62—Svea-Cresbard loams, 0 to 3 percent slopes. These very deep, level and nearly level, moderately well drained soils are on till plains. The Svea soil is on rises. The sodic Cresbard soil is in swales. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 40 to 55 percent Svea soil and 35 to 50 percent Cresbard soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is loam about 25 inches thick. It is very dark grayish brown in the upper part, dark brown in the next part, and olive brown and calcareous in the lower part. The substratum to a depth of about 60 inches is olive brown, calcareous loam. In some places the dark color of the surface layer extends to a depth of only 8 to 15 inches.

Typically, the surface layer of the Cresbard soil is black loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 2 inches thick. The next layer is very dark grayish brown clay loam about 5 inches thick. The subsoil is dense. It is about 14 inches thick. It is very dark grayish brown clay loam in the upper part, dark grayish brown clay loam in the next part, and light brownish gray, calcareous loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the subsoil is very dense. In other places it has less clay.

Included with these soils in mapping are small areas of Buse, Hamerly, Tonka, and Vallers soils. These included soils make up about 5 to 10 percent of the unit. The Buse soils are well drained. They are on knolls. The Hamerly and Vallers soils are on flats. The Hamerly soils are somewhat poorly drained. The Vallers soils are saline. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately slow in the Svea soil and slow in the Cresbard soil. Runoff is slow on both soils. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet. Tilth is fair. The dense, sodic subsoil of the Cresbard soil restricts the rooting depth of plants.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Because of moisture stress in most years, crop growth on the Cresbard soil is uneven, especially as the crop nears maturity. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. Timely tillage and additions of organic material improve tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, improves root penetration in the dense subsoil of the Cresbard soil. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are big bluestem, western wheatgrass, and green needlegrass. Smooth bromegrass, intermediate wheatgrass, green needlegrass, and alfalfa are suitable hay and pasture plants. No major hazards or limitations affect the use of these soils for range or pasture.

The Svea soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cresbard soil is suited to many of the climatically adapted species. Individual trees and shrubs growing on the Cresbard soil vary in height, density, and vigor, which are affected by the

restricted root development in the dense subsoil and the reduced amount of available water caused by the salts in the soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of the Svea soil is IIc, and that of the Cresbard soil is IIIs. The range site of the Svea soil is Overflow, and that of the Cresbard soil is Clayey. The pasture group of the Svea soil is Overflow and Run-on, and that of the Cresbard soil is Clayey Subsoil. The productivity index of the unit for spring wheat is 84.

62B—Barnes-Cresbard loams, 3 to 6 percent slopes. These very deep, undulating soils are on till plains. The well drained Barnes soil is on rises. The moderately well drained, sodic Cresbard soil is in swales. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 50 to 65 percent Barnes soil and 30 to 45 percent Cresbard soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 7 inches thick. The subsoil is loam about 22 inches thick. It is dark brown in the upper part and grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous loam. In some places the dark color of the surface layer and subsoil extends to a depth of more than 16 inches. In other places the surface layer and subsoil are thinner and lighter colored.

Typically, the surface layer of the Cresbard soil is black loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 2 inches thick. The next layer is very dark grayish brown clay loam about 5 inches thick. The subsoil is dense. It is about 14 inches thick. It is very dark grayish brown clay loam in the upper part, dark grayish brown clay loam in the next part, and light brownish gray, calcareous loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the subsoil is very dense. In other places it has less clay.

Included with these soils in mapping are small areas of Clontarf, Embden, Hamerly, and Tonka soils. These included soils make up about 5 to 10 percent of the unit. The Clontarf and Embden soils are intermingled with areas of the Barnes soil. The Clontarf soils have a substratum of fine sand. The Embden soils are fine sandy loam throughout the profile. The Hamerly soils are somewhat poorly drained. They are on flats. The Tonka soils are poorly drained. They are in depressions.

Permeability is moderately slow in the Barnes soil and slow in the Cresbard soil. Runoff is medium on both soils. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet in the Cresbard soil. Tilth is fair. The dense, sodic subsoil of the Cresbard soil restricts the rooting depth of plants.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main management concerns in cultivated areas are maintaining tilth and controlling water erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay and pasture help to control water erosion and maintain or improve tilth. Because of moisture stress in most years, crop growth on the Cresbard soil is uneven, especially as the crop nears maturity. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. Timely tillage and additions of organic material improve tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, improves root penetration in the dense subsoil of the Cresbard soil. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, needleandthread, and green needlegrass. Smooth bromegrass, green needlegrass, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control water erosion.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cresbard soil is suited to many of the climatically adapted species. Individual trees and shrubs growing on the Cresbard soil vary in height, density, and vigor, which are affected by the restricted root development in the dense subsoil and the reduced amount of available water caused by the salts in the soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of the Barnes soil is IIe, and that of the Cresbard soil is IIIe. The range site

of the Barnes soil is Silty, and that of the Cresbard soil is Clayey. The pasture group of the Barnes soil is Loamy and Silty, and that of the Cresbard soil is Clayey Subsoil. The productivity index of the unit for spring wheat is 69.

63—Cresbard-Cavour loams, 0 to 3 percent slopes. These very deep, level and nearly level, moderately well drained, sodic soils are on till plains. The Cresbard soil is on rises. The Cavour soil is in swales. Individual areas of this unit range from about 5 to more than 600 acres in size. They are about 50 to 65 percent Cresbard soil and 25 to 40 percent Cavour soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Cresbard soil is black loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 2 inches thick. The next layer is very dark grayish brown clay loam about 5 inches thick. The subsoil is dense. It is about 14 inches thick. It is very dark grayish brown clay loam in the upper part, dark grayish brown clay loam in the next part, and light brownish gray, calcareous loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous loam. In some places the soil has less sand throughout the profile.

Typically, the surface layer of the Cavour soil is black loam about 9 inches thick. The subsurface layer is very dark gray fine sandy loam about 2 inches thick. The subsoil is dense. It extends to a depth of about 60 inches. In sequence downward it is black and very dark brown silty clay; dark grayish brown, mottled silty clay; grayish brown, mottled, calcareous clay loam; and dark grayish brown, mottled, calcareous clay loam. In some places the soil has less sand throughout the profile.

Included with these soils in mapping are small areas of Hamerly, Miranda, Parnell, and Svea soils. These included soils make up about 5 to 20 percent of the unit. The Hamerly and Miranda soils are somewhat poorly drained. They are on flats. The Parnell soils are very poorly drained. They are in depressions. The Svea soils do not have a sodic subsoil. They are intermingled with areas of the Cresbard soil. Also included are small areas of a poorly drained, sodic soil. This soil is in shallow depressions.

Permeability is slow in the Cresbard and Cavour soils. Runoff also is slow. Available water capacity is high in the Cresbard soil and moderate in the Cavour soil. The seasonal high water table is at a depth of 4 to 6 feet in both soils. Tilth is fair. The dense, sodic subsoil restricts the rooting depth of plants.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main concerns in cultivated areas are maintaining tilth and controlling erosion. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay and pasture help to control erosion and maintain or improve tilth. Because of moisture stress in most years, crop growth is uneven, especially as the crop nears maturity. The surface tends to puddle when wet and to form clods when dry. Tillage when the soils are neither too wet nor too dry help to maintain tilth. Timely tillage and additions of organic material improve tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, improves root penetration in the dense subsoil. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass and green needlegrass. Western wheatgrass, slender wheatgrass, Russian wildrye, and sweetclover are suitable hay and pasture plants. The dense, sodic subsoil, which restricts root penetration, and the salts, which reduce the amount of available water, are limitations, especially if the range or pasture is overgrazed. Denuding can occur in the overgrazed areas of range or pasture. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important or suitable plants helps to prevent denuding. Stock water ponds constructed in areas of the Cavour soil sometimes contain salty water.

The Cresbard soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cavour soil is suited to only a few of the drought- and salt-tolerant species. Irrigation or supplemental watering helps to ensure the survival of seedlings. Individual trees and shrubs growing on these soils vary in height, density, and vigor, which are affected by the restricted root development in the dense subsoil and the reduced amount of available water caused by the salts in the soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of the Cresbard soil is IIIs, and that of the Cavour soil is IVs. The range site of the Cresbard soil is Clayey, and that of the Cavour soil is Claypan. The pasture group of the Cresbard soil is Clayey Subsoil, and that of the Cavour soil is Claypan. The productivity index of the unit for spring wheat is 63.

64—Cavour-Miranda loams, 0 to 3 percent slopes. These very deep, level and nearly level soils are on till plains. The moderately well drained, sodic Cavour soil is on rises. The somewhat poorly drained, sodic-saline Miranda soil is in swales. Individual areas of this unit range from about 5 to more than 50 acres in size. They are about 50 to 65 percent Cavour soil and 20 to 35 percent Miranda soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Cavour soil is black loam about 9 inches thick. The subsurface layer is very dark gray fine sandy loam about 2 inches thick. The subsoil is dense. It extends to a depth of about 60 inches. In sequence downward it is black and very dark brown silty clay; dark grayish brown, mottled silty clay; grayish brown, mottled, calcareous clay loam; and dark grayish brown, mottled, calcareous clay loam. In some places the soil has less sand throughout the profile. In other places the subsoil is not so dense.

Typically, the surface layer of the Miranda soil is black loam about 6 inches thick. The subsoil is dense. It is about 28 inches thick. It is very dark gray clay loam in the upper part; dark grayish brown, calcareous loam in the next part; and grayish brown, mottled, calcareous loam in the lower part. The substratum to a depth of about 60 inches is dark gray, mottled, calcareous loam. In some places the surface layer is only 2 to 5 inches thick. In other places the soil has less sand throughout the profile.

Included with these soils in mapping are small areas of Hamerly, Svea, Tonka, and Vallers soils. These included soils make up about 5 to 15 percent of the unit. They do not have a sodic subsoil. The Hamerly and Vallers soils are on flats. The Svea soils are on rises. The Tonka soils are in depressions. Also included are small areas of a poorly drained soil that has a dense, sodic subsoil. This soil is in shallow depressions.

Permeability is slow in the Cavour soil and very slow in the Miranda soil. Runoff is slow on both soils. Available water capacity is moderate. A seasonal high table is at a depth of 4 to 6 feet in the Cavour soil and at a depth of 2 to 4 feet in the Miranda soil. Tilth is poor. The surface of the Miranda soil is hard and crusted when dry and dispersed when wet. The dense, sodic subsoil of both soils restricts the rooting depth of plants. The salinity in the subsoil of the Miranda soil restricts the growth of plants.

Most areas are used for cultivated crops. Some areas are used for pasture or hay. These soils are poorly suited to cultivated crops. They are suited to grass-legume hay and pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are maintaining tilth and overcoming the salinity. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion, overcome salinity, and maintain or improve tilth. Because of moisture stress in most years, crop growth is uneven, especially as the crop nears maturity. The surface tends to puddle when wet and to form clods when dry. Tillage when the soils are neither too wet nor too dry helps to maintain tilth. Timely tillage and additions of organic material improve tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, improves root penetration in the dense subsoil of these soils. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, and blue grama. Western wheatgrass, slender wheatgrass, crested wheatgrass, and sweetclover are suitable hay and pasture plants. The dense, sodic subsoil, which restricts root penetration, and the salts, which reduce the amount of available water, are limitations, especially if the range or pasture is overgrazed. Denuding can occur in the overgrazed areas of range or pasture. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important or suitable plants helps to prevent denuding. Stock water ponds constructed in areas of these soils sometimes contain salty water.

The Cavour soil is suited to only a few of the drought- and salt-tolerant climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Miranda soil generally is unsuited to the climatically adapted species. Irrigation and supplemental watering help to ensure the survival of seedlings in areas of the Cavour soil. Individual trees and shrubs vary in height, density, and vigor, which are affected by the restricted root development in the dense, sodic subsoil and the reduced amount of available water caused by the salts in the soil.

The land capability classification of the Cavour soil is IVs, and that of the Miranda soil is VIs. The range site and pasture group of the Cavour soil are Claypan, and those of the Miranda soil are Thin Claypan. The productivity index of the unit for spring wheat is 33.

66—Exline silt loam. This very deep, level, somewhat poorly drained, sodic-saline soil is on flats on lake plains and in channels. Individual areas range from about 3 to more than 600 acres in size.

Typically, the surface layer is very dark gray silt loam about 1 inch thick. The subsoil is dense. It is about 27 inches thick. It is black clay loam in the upper part, very

dark gray clay loam in the next part, and dark gray, calcareous silty clay loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, calcareous silty clay loam. In some places the surface layer is as much as 5 inches thick.

Included with this soil in mapping are small areas of Aberdeen, Cavour, and saline Colvin soils. These soils make up about 5 to 10 percent of the unit. The Aberdeen and Cavour soils are moderately well drained. They are on rises. The Colvin soils are poorly drained. They are in depressions. Also included are small areas of a poorly drained soil that has a dense, sodic subsoil. This soil is in shallow depressions or it is intermingled with areas of the Exline soil.

Permeability is very slow in the Exline soil. Runoff also is very slow. Available water capacity is moderate. The seasonal high water table is at a depth of 2.5 to 4.0 feet. Tilth is poor. The dense, sodic subsoil restricts the rooting depth of plants. The salinity in the subsoil restricts the growth of plants.

Most areas are used for range, but some areas are used for hay. This soil is best suited to these uses. It generally is unsuited to cultivated crops and trees and shrubs because of the dense, sodic subsoil. The hazards of water erosion and soil blowing are slight.

In areas where these soils are used as range, the important native forage plants are western wheatgrass and blue grama. Western wheatgrass, slender wheatgrass, and alfalfa are suitable hay and pasture plants. The dense, sodic subsoil, which restricts root penetration, and the salts, which reduce the amount of available water, are limitations, especially if the range or pasture is overgrazed. Denuding can occur in the overgrazed areas of range or pasture. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important or suitable plants helps to prevent denuding. Stock water ponds constructed in areas of this soil frequently contain salty water.

The land capability classification is VIs. The range site and pasture group are Thin Claypan. The productivity index for spring wheat is 0.

70—Colvin silty clay loam, wet. This very deep, level, very poorly drained, highly calcareous soil is in depressions on lake plains and in channels. It is ponded. Individual areas range from about 5 to more than 150 acres in size.

Typically, the surface layer is black, calcareous silty clay loam about 7 inches thick. The subsoil is mottled, calcareous silty clay loam about 23 inches thick. It is dark gray in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is gray in the upper part and light brownish gray in the lower part. In some places the soil has more clay throughout. In other places it is slightly saline.

Included with this soil in mapping are small areas of Fargo and Vallers soils. These soils make up about 5 to 30 percent of the unit. The Fargo and Vallers soils are poorly drained. They are on rises. Also included are small areas of the moderately saline Colvin soils. These soils are on the rim of the depressions.

Permeability is moderately slow in the Colvin soil, and runoff is ponded. Available water capacity is high. The seasonal high water table is 1 foot above to 1 foot below the surface. Tilth is fair.

Most areas are used for hay or wetland wildlife habitat. Some areas are drained and cultivated. If drained, this soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay or pasture. If undrained, it is best suited to native hay, range, or wetland wildlife habitat. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. Because locating suitable drainage outlets is often difficult, few areas are drained. In undrained areas crops are planted and harvested in only about 2 years out of 10. Drainage can increase the salinity. The main management concerns in cultivated areas are overcoming the salinity and controlling the soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and minimize surface salinity. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

Areas of this soil and the ponded water provide excellent winter cover for resident wildlife and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wildlife habitat are minimizing siltation and maintaining the natural water level.

In areas where this soil is used for range, the important native forage plants are slough sedge and rivergrass. If this soil is drained, reed canarygrass and creeping foxtail are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing and minimize surface salinity. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting

the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIIw. The range site is Wetland. The pasture group is Wet. The productivity index for spring wheat ranges from 10 to 60, depending on the degree of drainage.

72—Minnewaukan loamy sand, loamy substratum, 0 to 3 percent slopes. This very deep, level and nearly level, poorly drained soil is on the beaches of lake plains. It is occasionally flooded. Individual areas range from about 5 to more than 80 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous loamy sand about 8 inches thick. The substratum is calcareous. The upper part is dark grayish brown gravelly sand, the next part is gray, mottled sand, and the lower part to a depth of about 60 inches is olive gray, mottled clay loam. In some places the layer of clay loam in the substratum is at a depth of less than 40 inches. In other places the surface layer is loam and is 2 to 8 inches thick.

Included with this soil in mapping are small areas of Sioux and Ulen soils. These soils make up about 10 to 30 percent of the unit. They are on rises. The Sioux soils are excessively drained. The Ulen soils are somewhat poorly drained.

Permeability is rapid in the upper part of the Minnewaukan soil and moderately slow in the lower part. Runoff is very slow. Available water capacity is moderate. The seasonal high water table is within a depth of 2 feet. Tilth is good.

Most areas are used for range or wildlife habitat. Some areas are used for hay. This soil is best suited to range, pasture, and wildlife habitat. It is poorly suited to cultivated crops. The hazard of water erosion is slight, and the hazard of soil blowing is severe. The main management concerns in cultivated areas are overcoming the droughtiness and controlling soil blowing in drained areas and controlling the wetness and the soil blowing in undrained areas. Because locating suitable drainage outlets is often difficult, few areas are drained. In areas where the soil is drained and cultivated, applying a system of conservation tillage that leaves crop residue on the surface and establishing windbreaks help to control soil blowing. Leaving tall stubble on the surface helps to overcome the droughtiness by trapping snow and thus increasing the moisture supply. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

Areas of this soil provide excellent food and cover for resident wildlife and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concern in managing wetland wildlife habitat is maintaining the natural wetness.

In areas where this soil is used as range, the important native forage plants are big bluestem and switchgrass. Big bluestem, creeping foxtail, reed canarygrass, and alsike clover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IVs. The range site is Subirrigated. The pasture group is Wet. The productivity index for spring wheat is 18.

73—Overly-Bearden silty clay loams, 0 to 3 percent slopes. These very deep soils are on lake plains. The level and nearly level, moderately well drained Overly soil is on rises. The level, somewhat poorly drained, highly calcareous Bearden soil is in swales. Individual areas of this unit range from about 5 to more than 320 acres in size. They are about 55 to 70 percent Overly soil and 25 to 40 percent Bearden soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Overly soil is black silty clay loam about 14 inches thick. The subsoil is silty clay loam about 18 inches thick. It is black in the upper part and dark grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay loam. In some places the dark color of the surface layer extends to a depth of only 8 to 15 inches. In other places the surface layer is silt loam.

Typically, the surface layer of the Bearden soil is

black, calcareous silty clay loam about 8 inches thick. The mottled, calcareous subsoil is about 29 inches thick. It is dark grayish brown silty clay loam in the upper part, light olive brown silty clay loam in the next part, and light olive brown silt loam in the lower part. The substratum to a depth of about 60 inches is olive gray, mottled, and calcareous. It is silt loam in the upper part and loam in the lower part. In some places the surface layer is silt loam. In other places it is noncalcareous. In some areas it is slightly saline.

Included with these soils in mapping are small areas of Aberdeen, Colvin, and Sinai soils. These included soils make up about 5 to 10 percent of the unit. The Aberdeen and Sinai soils are intermingled with areas of the Overly soil. The Aberdeen soils have a sodic subsoil. The Sinai soils have a subsoil and substratum of silty clay. The Colvin soils are very poorly drained. They are in depressions.

Permeability is moderately slow in the Overly and Bearden soils. Runoff is slow. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet in the Overly soil and at a depth of 2 to 4 feet in the Bearden soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range. These soils are suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight. The hazard of soil blowing is slight on the Overly soil and moderate on the Bearden soil. The main management concerns in cultivated areas are maintaining tilth and controlling soil blowing. Applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, little bluestem, and green needlegrass. Smooth bromegrass, big bluestem, sweetclover, and alfalfa are suitable hay and pasture plants. The soil blowing in areas of the Bearden soil is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing.

These soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of the Overly soil is IIc, and that of the Bearden soil is IIe. The range site of the Overly soil is Silty, and that of the Bearden soil is Limy Subirrigated. The pasture group of the Overly soil is Loamy and Silty, and that of the Bearden soil is Limy Subirrigated. The productivity index of the unit for spring wheat is 96.

73B—Great Bend-Overly silty clay loams, 3 to 6 percent slopes. These very deep, gently sloping soils are on lake plains. The well drained Great Bend soil is on rises. The moderately well drained Overly soil is in swales. Individual areas of this unit range from about 5 to more than 100 acres in size. They are about 55 to 75 percent Great Bend soil and 15 to 30 percent Overly soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Great Bend soil is very dark gray silty clay loam about 7 inches thick. The subsoil is silt loam about 13 inches thick. It is dark brown in the upper part and light olive brown, mottled, and calcareous in the lower part. The substratum is calcareous. The upper part is light olive brown, mottled silt loam; the next part is grayish brown, mottled silt loam; and the lower part to a depth of about 60 inches is dark grayish brown loamy very fine sand. In some places the surface layer is silt loam.

Typically, the surface soil of the Overly soil is black silty clay loam about 14 inches thick. The subsoil is silty clay loam about 18 inches thick. It is black in the upper part and dark grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay loam. In some places the surface layer is silt loam.

Included with these soils in mapping are small areas of Aberdeen, Bearden, Colvin, and Sinai soils. These included soils make up about 5 to 20 percent of the unit. The Aberdeen and Sinai soils are intermingled with areas of the Overly soil. The Aberdeen soils have a sodic subsoil. The Sinai soils have a subsoil and substratum of silty clay. The Bearden soils are somewhat poorly drained. They are on flats. The Colvin soils are very poorly drained. They are in depressions.

Permeability is moderately slow in the Great Bend and Overly soils. Runoff is medium. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet in the Overly soil. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, flax, and barley and to

grasses and legumes for hay or pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main management concerns in cultivated areas are maintaining tilth and controlling water erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, needleandthread, and green needlegrass. Smooth bromegrass, big bluestem, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control water erosion.

The Great Bend soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Overly soil is suited to all of the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIe. The range site is Silty. The pasture group is Loamy and Silty. The productivity index of the unit for spring wheat is 81.

74—Aberdeen silty clay loam. This very deep, level, moderately well drained, sodic soil is on flats on lake plains. Individual areas range from about 5 to more than 100 acres in size.

Typically, the surface soil is black silty clay loam about 12 inches thick. The next layer is very dark gray silty clay loam about 3 inches thick. The subsoil is dense. It is about 29 inches thick. It is very dark gray silty clay in the upper part and grayish brown, mottled, calcareous silty clay loam in the lower part. The substratum to a depth of about 60 inches is olive, mottled, calcareous silty clay loam. In some places the subsoil is very dense.

Included with this soil in mapping are small areas of Bearden, Fargo, Overly, and Sinai soils. These soils make up about 5 to 30 percent of the unit. The Bearden soils are somewhat poorly drained. They are in swales. The Fargo soils are poorly drained. They are in depressions. The Overly and Sinai soils do not have a sodic subsoil. They are intermingled with areas of the Aberdeen soil.

Permeability is slow in the Aberdeen soil, and runoff is very slow. Available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet. Tilth is fair. The dense, sodic subsoil restricts the rooting depth of plants.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Because of moisture stress in most years, crop growth is uneven, especially as the crop nears maturity. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. Timely tillage and additions of organic material improve tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, improves root penetration in the dense subsoil. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass and green needlegrass. Smooth bromegrass, Russian wildrye, green needlegrass, and alfalfa are suitable hay and pasture plants. No major hazards or limitations affect the use of this soil for range or pasture. Maintaining an adequate cover of the important or suitable plants helps to prevent erosion.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs growing on this soil vary in height, density, and vigor, which are affected by the restricted root development in the dense subsoil and the reduced amount of available water caused by the salts in the soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification is IIIs. The range site is Clayey. The pasture group is Clayey Subsoil. The productivity index for spring wheat is 67.

76—Fargo-Colvin silty clay loams. These very deep, level, poorly drained soils are on lake plains. The Fargo soil is in swales. The highly calcareous Colvin soil is on flats. Individual areas of this unit range from about 5 to more than 60 acres in size. They are about

60 to 75 percent Fargo soil and 15 to 30 percent Colvin soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface soil of the Fargo soil is black silty clay loam about 11 inches thick. The subsoil is silty clay about 18 inches thick. It is very dark gray in the upper part, dark gray in the next part, and dark grayish brown, mottled, and calcareous in the lower part. The substratum to a depth of about 60 inches is grayish brown, mottled, calcareous silty clay. In some places the surface layer has free carbonates. In other places the soil has less clay throughout the profile.

Typically, the surface layer of the Colvin soil is black, calcareous silty clay loam about 7 inches thick. The subsoil is mottled, calcareous silty clay loam about 23 inches thick. It is dark gray in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is gray in the upper part and light brownish gray in the lower part. In some places the soil has more clay. In other places it is slightly saline.

Included with these soils in mapping are small areas of Aberdeen and Bearden soils. These included soils make up about 10 to 15 percent of the unit. The Aberdeen and Bearden soils are on rises. The Aberdeen soils are moderately well drained. The Bearden soils are somewhat poorly drained.

Permeability is slow in the Fargo soil and moderately slow in the Colvin soil. Runoff is very slow on both soils. Available water capacity is high. The seasonal high water table is within a depth of 3 feet in the Fargo soil and within a depth of 1 foot in the Colvin soil. Tilth is fair.

Most areas are used for cultivated crops. Some areas are used for range or pasture. These soils are suited to wheat, sunflowers, barley, and flax and to grasses and legumes for hay and pasture. The hazard of water erosion is slight on both soils. The hazard of soil blowing is slight on the Fargo soil and moderate on the Colvin soil. The main management concerns in cultivated areas are maintaining tilth, controlling soil blowing, and overcoming wetness. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage can increase the salinity. In areas where the soil is drained and cultivated, applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing, minimize surface salinity, and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are green needlegrass and western wheatgrass on the Fargo soil and big bluestem, switchgrass, and prairie cordgrass on the Colvin soil. If the Fargo soil is drained, reed canarygrass and alfalfa are suitable hay and pasture plants. Creeping foxtail and reed canarygrass are suitable hay and pasture plants on the Colvin soil. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing and to minimize surface salinity. Compaction, trampling, and root shearing are problems if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

If drained, these soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on these soils are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification of both soils is IIw. The range site of the Fargo soil is Clayey, and that of the Colvin soil is Subirrigated. The pasture group of both soils is Wet. The productivity index of the unit for spring wheat ranges from 40 to 80, depending on the degree of drainage.

77—Colvin silty clay loam. This very deep, level, poorly drained, highly calcareous soil is on flats on lake plains. Individual areas range from about 5 to more than 200 acres in size.

Typically, the surface layer is black, calcareous silty clay loam about 7 inches thick. The subsoil is mottled, calcareous silty clay loam about 23 inches thick. It is dark gray in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is gray in the upper part and light brownish gray in the lower part. In some places the soil has more clay. In other places it is slightly saline. In some areas the substratum is loamy sand or sand below a depth of 40 inches. In other areas the soil is moderately saline.

Included with this soil in mapping are small areas of Aberdeen, Fargo, and Hamerly soils. These soils make up about 5 to 20 percent of the unit. The Aberdeen and Hamerly soils are on rises. The Aberdeen soils are

moderately well drained. The Hamerly soils are somewhat poorly drained. The Fargo soils have a subsoil of silty clay. They are intermingled with areas of the Colvin soil. Also included are small areas of Colvin soils that are ponded. The Colvin soils that are ponded are in depressions.

Permeability is moderately slow in the Colvin soil, and runoff is very slow. Available water capacity is high. The seasonal high water table is within a depth of 1 foot. Tilth is fair.

Most areas are used for cultivated crops. Some areas are used for range, hay, or wildlife habitat. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay or pasture. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The main management concerns in cultivated areas are overcoming wetness, controlling soil blowing, and maintaining tilth. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage can increase the salinity. In areas where the soil is drained and cultivated, applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing, minimize surface salinity, and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem, switchgrass, and prairie cordgrass. Creeping foxtail, reed canarygrass, and alsike clover are suitable hay and pasture plants. Soil blowing is a hazard, especially is the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing. Compaction, trampling, and root shearing are problems if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIw. The range site is Subirrigated. The pasture group is Wet. The productivity index for spring wheat ranges from 40 to 70, depending on the degree of drainage.

79B—Sinai silty clay loam, 0 to 6 percent slopes. This very deep, level to gently sloping, moderately well drained soil is on flats and rises on lake plains. Individual areas range from about 5 to more than 300 acres in size.

Typically, the surface layer is black. It is about 8 inches thick. It is silty clay loam in the upper part and silty clay in the lower part. The subsoil is silty clay about 21 inches thick. It is very dark grayish brown in the upper part and dark grayish brown and calcareous in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay. In some places the dark color of the surface layer extends to a depth of only 8 to 15 inches. In other places slope is more than 6 percent.

Included with this soil in mapping are small areas of Aberdeen, Barnes, Fargo, and Overly soils. These soils make up about 5 to 10 percent of the unit. The Aberdeen and Overly soils are intermingled with areas of the Sinai soil. The Aberdeen soils have a dense, sodic subsoil. The Overly soils have a subsoil of silty clay loam. The Barnes soils are well drained. They are on rises. The Fargo soils are poorly drained. They are in swales and depressions.

Permeability is slow in the Sinai soil, and runoff is medium. Available water capacity is high. Tilth is fair.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main management concerns in cultivated areas are maintaining tilth and controlling water erosion. Grassed waterways are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control water erosion and maintain or improve tilth. Conservation tillage and grassed waterways also help to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass and green needlegrass. Smooth bromegrass, Russian wildrye, green needlegrass, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control water erosion.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover

improve the growth rates of the seedlings.

The land capability classification is IIe. The range site and pasture group are Clayey. The productivity index for spring wheat is 82.

88C—Seelyeville mucky peat, 0 to 9 percent slopes. This very deep, level to moderately sloping, very poorly drained soil is on foot slopes in stream valleys and in drainageways on till plains and outwash plains. Individual areas range from about 3 to more than 80 acres in size.

Typically, the surface layer is black, calcareous mucky peat about 2 inches thick. Below this are calcareous layers to a depth of about 60 inches. In sequence downward they are very dark grayish brown mucky peat, very dark gray muck, and very dark grayish brown muck.

Included with this soil in mapping are small areas of the poorly drained Lamoure and Marysland soils. These soils make up about 5 to 20 percent of the unit. They are mineral soils. They are intermingled with areas of the Seelyeville soil.

Permeability is moderate in the Seelyeville soil, and runoff is very slow. Available water capacity is very high. The seasonal high water table is within a depth of 2 feet.

Most areas are used as wetland wildlife habitat. This soil is best suited to this use. It generally is unsuited to cultivated crops, range, and pasture and to the trees and shrubs grown as windbreaks and environmental plantings because of poor trafficability, the ponding, and the difficulty in locating suitable drainage outlets. Areas of this soil and the ponded water provide excellent winter cover for resident wildlife and high-quality feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are minimizing siltation and maintaining the natural water level.

The land capability classification is VIIIw. No range site or pasture group is assigned. The productivity index for spring wheat is 0.

90—Lamoure silty clay loam. This very deep, level, poorly drained, calcareous soil is in swales and oxbows on flood plains. It is occasionally flooded. Individual areas range from about 5 to more than 100 acres in size.

Typically, the surface soil is silty clay loam about 35 inches thick. It is black in the upper part, black and calcareous in the next part, and very dark gray and calcareous in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is dark gray in the upper part and dark olive gray in the lower part. In some places the surface layer is silt loam. In other places the soil is slightly saline.

Included with this soil in mapping are small areas of Colvin and La Prairie soils. These soils make up about 5 to 10 percent of the unit. The Colvin soils have an accumulation of lime within 16 inches of the surface. They are intermingled with areas of the Lamoure soil. The La Prairie soils are moderately well drained. They are on rises.

Permeability is moderately slow in the Lamoure soil, and runoff is very slow. Available water capacity is high. The seasonal high water table is within a depth of 2 feet. Tilth is fair.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. The main management concerns in cultivated areas are overcoming wetness, controlling soil blowing, and maintaining tilth. Because locating suitable drainage outlets is often difficult, few areas are drained. Drainage can increase the salinity. In areas where the soil is drained and cultivated, applying a system of conservation tillage that leaves crop residue on the surface, establishing windbreaks, and growing grasses and legumes for hay or pasture help to control soil blowing, minimize surface salinity, and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem and switchgrass. Reed canarygrass, big bluestem, creeping foxtail, and alsike clover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control soil blowing. Compaction, trampling, and root shearing are problems if the range or pasture is grazed when wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the vegetation. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

The land capability classification is IIw. The range

site is Subirrigated. The pasture group is Wet. The productivity index for spring wheat ranges from 40 to 70, depending on the degree of drainage.

92—La Prairie and Lamoure soils, channeled. These very deep, level soils are on flood plains. They are occasionally flooded. The moderately well drained La Prairie soil is on flats and rises. The poorly drained, calcareous Lamoure soil is in channels and oxbows. Individual areas of this unit range from about 10 to more than 600 acres in size. They are dissected into small, irregularly shaped areas by meandering channels and oxbows. Many areas are isolated by deep channels or short, steep escarpments. Any one area can consist of all La Prairie soil, all Lamoure soil, or a combination of both soils.

Typically, the surface soil of the La Prairie soil is black silt loam about 14 inches thick. The subsoil is calcareous. The upper part is black silt loam, the next part is dark grayish brown silt loam, and the lower part to a depth of about 60 inches is dark brown loam. In some places the soil is loam throughout the profile.

Typically, the surface soil of the Lamoure soil is silty clay loam about 35 inches thick. It is black in the upper part, black and calcareous in the next part, and very dark gray in the lower part. The substratum to a depth of about 60 inches is mottled, calcareous silty clay loam. It is dark gray in the upper part and dark olive gray in the lower part. In some places the surface layer is silt loam. In other places the soil is slightly saline.

Included with these soils in mapping are small areas of Colvin and Vallers soils. These included soils make up about 5 to 15 percent of the unit. The Colvin and Vallers soils have an accumulation of lime within 16 inches of the surface. They are intermingled with areas of the Lamoure soil.

Permeability is moderate in the La Prairie soil and moderately slow in the Lamoure soil. Runoff is slow on both soils. Available water capacity is high. The seasonal high water table is within a depth of 2.0 feet in the Lamoure soil and at a depth of 3.5 to 6.0 feet in the La Prairie soil.

Most areas are used for range or wetland wildlife habitat. These soils are best suited to these uses and to pasture. Because of the meandering channels, these soils are generally unsuited to cultivated crops and to the machine-planted trees and shrubs grown as windbreaks and environmental plantings. Tillable areas are generally small and irregular in shape.

In areas where these soils are used as range, the important native forage plants are big bluestem, green needlegrass, western wheatgrass, and switchgrass. Big bluestem, smooth bromegrass, reed canarygrass, and alsike clover are suitable hay and pasture plants. Scouring and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control scouring and soil blowing. Compaction, trampling, and root shearing are problems if the range or pasture is grazed when the Lamoure soil is wet. Grazing should be deferred during wet periods.

The land capability classification of both soils is VIw. The range site of the La Prairie soil is Overflow, and that of the Lamoure soil is Subirrigated. The pasture group of the La Prairie soil is Overflow and Run-on, and that of the Lamoure soil is Wet. The productivity index of the unit for spring wheat is 0.

93—La Prairie silt loam, 0 to 3 percent slopes. This very deep, level and nearly level, moderately well drained soil is on flats on flood plains. It is subject to rare flooding. Individual areas range from about 5 to more than 200 acres in size.

Typically, the surface soil is black silt loam about 14 inches thick. The subsoil is calcareous. The upper part is black silt loam, the next part is dark grayish brown silt loam, and the lower part to a depth of about 60 inches is dark brown loam. In some places the soil is loam throughout the profile. In other places the lower part of the subsoil is mottled.

Included with this soil in mapping are small areas of Fordville and Lamoure soils. These soils make up about 5 to 10 percent of the unit. The Fordville soils are well drained. They are on terraces. The Lamoure soils are poorly drained. They are in swales.

Permeability is moderate in the La Prairie soil, and runoff is slow. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass and green needlegrass. Big bluestem, smooth bromegrass, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. Scouring during flooding is a hazard, especially if the range or pasture is

overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control scouring.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical soil limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification is IIc. The range site is Silty. The pasture group is Overflow and Run-on. The productivity index for spring wheat is 100.

94—Darnen loam, 0 to 3 percent slopes. This very deep, level and nearly level, well drained soil is on foot slopes in stream valleys. Individual areas range from about 5 to more than 200 acres in size.

Typically, the surface soil is black loam about 18 inches thick. The subsoil is loam about 14 inches thick. It is very dark grayish brown in the upper part and dark brown in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, calcareous loam. In some places the surface soil is silt loam. In other places the dark color of the surface layer extends to a depth of only 10 to 20 inches. In some areas in the James River Valley, the lower part of the substratum is weathered shale.

Included with this soil in mapping are small areas of Embden and Fordville soils. These soils make up about 5 to 15 percent of the unit. The Embden soils are moderately well drained. They are on toe slopes. The Fordville soils have a substratum of gravelly sand. They are intermingled with areas of the Darnen soil.

Permeability is moderate in the Darnen soil, and runoff is slow. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay or pasture. The hazards of water erosion and soil blowing are slight. The main management concerns in cultivated areas are maintaining tilth and controlling erosion. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control erosion and maintain or improve tilth. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem, green needlegrass, and western wheatgrass. Big bluestem, smooth bromegrass, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. No major hazards or limitations affect the use of this soil for range or pasture. Maintaining an adequate cover of the important or suitable plants helps to prevent erosion.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical soil limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification is IIc. The range site is Overflow. The pasture group is Overflow and Run-on. The productivity index for spring wheat is 96.

94B—Darnen loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on foot slopes in stream valleys. Individual areas range from about 5 to more than 200 acres in size.

Typically, the surface soil is black loam about 18 inches thick. The subsoil is loam about 14 inches thick. It is very dark grayish brown in the upper part and dark brown in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, calcareous loam. In some places the dark color of the surface layer extends to a depth of only 10 to 20 inches. In other places the surface soil is fine sandy loam. In some areas the slope is 6 to 9 percent. In some areas in the James River Valley, the lower part of the substratum is weathered shale.

Included with this soil in mapping are small areas of Embden and Fordville soils. These soils make up about 5 to 10 percent of the unit. They are intermingled with areas of the Darnen soil. The Embden soils are moderately well drained. The Fordville soils have a substratum of gravelly sand.

Permeability is moderate in the Darnen soil, and runoff is medium. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. Some areas are used for range or pasture. This soil is suited to wheat, sunflowers, flax, and barley and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main management concerns in cultivated areas are maintaining tilth and controlling water erosion. Grassed waterways or terraces are needed in areas where runoff concentrates. Applying a system of conservation tillage that leaves crop residue on the surface and growing grasses and legumes for hay or pasture help to control water erosion and maintain or improve tilth. Conservation tillage and grassed waterways also help to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass and green needlegrass. Smooth bromegrass, big bluestem, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important or suitable plants helps to control water erosion.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical soil limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

The land capability classification is IIe. The range site is Silty. The pasture group is Loamy and Silty. The productivity index for spring wheat is 86.

100—Pits, gravel. This map unit is in areas from which the soil material has been removed and the underlying sand and gravel mined. Many of the areas are abandoned, and the acreage is idle land. Most of the areas support little or no vegetation. They range from about 3 to more than 50 acres in size.

This unit generally is unsuited to agricultural uses unless the areas are reclaimed by leveling and topdressing with topsoil. In unreclaimed areas planting climatically adapted trees and shrubs can enhance wildlife habitat or increase the esthetic value.

This unit generally is unsuited to most recreational uses unless the areas are reclaimed by leveling and topdressing with suitable topsoil. Areas that have had a regrowth of trees, shrubs, and grasses provide excellent cover for resident wildlife. With the exception of areas that have a seasonal high water table, this unit generally is unsuited to wetland wildlife habitat.

No land capability classification, range site, or pasture group is assigned. The productivity index for spring wheat is 0.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 615,000 acres in the survey area, or nearly 42 percent of the total acreage, meets the soil requirements for prime farmland.

The map units in the survey area that are considered prime farmland are listed at the end of this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in this section. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

The map units that meet the requirements for prime farmland are:

3	Tonka silt loam (where drained)
5	Hamerly-Tonka complex, 0 to 3 percent slopes (where drained)
15	Hamerly loam, 0 to 3 percent slopes
16	Hamerly-Wyard loams, 0 to 3 percent slopes (where drained)
18	Hamerly-Svea loams, 0 to 3 percent slopes
23B	Barnes-Svea loams, 3 to 6 percent slopes

24	Svea-Barnes loams, 0 to 3 percent slopes
24B	Svea-Buse loams, 3 to 6 percent slopes
40	Divide-Marysland loams, 0 to 3 percent slopes (where drained)
49	Wyndmere fine sandy loam, 0 to 3 percent slopes
56	Swenoda fine sandy loam, 0 to 3 percent slopes
56B	Swenoda-Buse complex, 3 to 6 percent slopes
57B	Embden fine sandy loam, 0 to 6 percent slopes
73	Overly-Bearden silty clay loams, 0 to 3 percent slopes
73B	Great Bend-Overly silty clay loams, 3 to 6 percent slopes
76	Fargo-Colvin silty clay loams (where drained)
77	Colvin silty clay loam (where drained)
79B	Sinai silty clay loam, 0 to 6 percent slopes
90	Lamoure silty clay loam (where drained)
93	La Prairie silt loam, 0 to 3 percent slopes
94	Darnen loam, 0 to 3 percent slopes
94B	Darnen loam, 3 to 6 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Prepared by Douglas A. Gasseling, agronomist, and James A. Clapper, district conservationist, Natural Resources Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

About 71 percent of Stutsman County is cultivated. In 1990, about 484,800 acres was used for close-grown crops, 145,000 acres for row crops, and 105,000 acres for forage crops *(19)*. During the period 1983 to 1987, the acreage used for close-grown crops averaged 507,900 acres per year *(18)*. The acreage of summer fallow was 175,000 acres in 1988, 120,000 acres in 1989, and 110,000 acres in 1990 *(19)*. The acreage used for sunflowers is decreasing. It averaged 157,000 acres per year during the period 1983 to 1987 but was 125,500 acres in 1988 and only 110,000 acres in 1989. The acreage used for corn and forage has been stable in recent years. In 1990, the acreages of the principal close-grown crops were as follows—spring wheat, 340,000 acres; durum wheat, 54,000 acres; winter wheat, 3,000 acres; barley, 55,000 acres; oats, 20,000 acres; rye, 3,300 acres; and flax, 9,500 acres. The main row crops were sunflowers and corn. Sunflowers were grown on 125,000 acres and corn on 20,000 acres. Alfalfa was grown on 45,000 acres and other hay crops on 60,000 acres. Small acreages were planted to mustard, buckwheat, sorghum, millet, or safflower. In 1990, about 167,975 acres was enrolled in the Conservation Reserve Program.

The potential of the soils in Stutsman County for increased production of food and fiber is good. This production is steadily increasing as the latest crop production technology is applied. This soil survey can facilitate the application of this technology.

The soils and climate of the county are suited to

most of the crops that are grown in the survey area. The crops that are not commonly grown but are suitable include lentils, potatoes, and rapeseed.

The principal management measures that help to ensure continuing productivity are those that control soil blowing and water erosion, maintain or improve fertility and tilth, and result in proper utilization of soil moisture.

Water erosion and soil blowing reduce the productivity of the soils. If the surface layer is lost, most of the available plant nutrients also are lost. As a result, applications of fertilizer are needed to maintain adequate crop production.

Of equal concern is the loss of organic matter through erosion. Soil structure, water infiltration, available water capacity, and tilth are all negatively affected by this loss. As organic matter is lost and the subsoil is exposed and tilled, the remaining soil becomes increasingly susceptible to both soil blowing and water erosion.

Soil blowing is a hazard on some of the soils in Stutsman County. It is a severe hazard on the coarse textured and moderately coarse textured soils, including Arvilla, Clontarf, Embden, Fossum, Hecla, Larson, Maddock, Minnewaukan, Sioux, Swenoda, Towner, Ulen, and Wyndmere soils.

Arveson, Buse, Colvin, Divide, Hamerly, Ulen, and Wyndmere soils have a relatively high content of lime and are susceptible to soil blowing in the spring if they have been bare throughout the winter. Because of freezing and thawing, soil structure breaks down, resulting in aggregates that are susceptible to movement. Nearly all soils can be damaged by soil blowing if they are bare.

Water erosion is a severe hazard on gently sloping and steeper soils, such as Barnes, Buse, Kloten, and Svea soils. It also is a severe hazard on the more gently sloping soils that have long slopes. The hazard is greatest when the surface is bare.

Conservation practices that control both soil blowing and water erosion are those that maintain a protective plant cover. Examples are conservation tillage systems that keep a protective amount of crop residue on the surface. Applications of herbicide can help to eliminate the need for summer fallow tillage. Cover crops also are effective in controlling both soil blowing and water erosion. Field windbreaks, annual wind barriers, and stripcropping help to control soil blowing. A cropping sequence that includes grasses and legumes, grassed waterways, diversions, terraces, contour farming, and field stripcropping across the slope help to control water erosion. A management system that includes several measures is the best means of protecting the soil. For example, conservation tillage can control soil blowing during years when the amount of crop residue is adequate, but windbreaks are needed during years when the amount of residue is low.

Moisture at planting time is critical to the success of the crop during the growing season. In years when the amount of available soil moisture is low at planting time, the success of cropping is greatly reduced. Measures that reduce evaporation and runoff rates, increase the rate of water infiltration, and control weeds conserve moisture. Examples are stubble mulching; a system of conservation tillage, such as mulch tillage or no-till farming; stripcropping; cover crops; crop residue management; standing stubble and annual wind barriers, which trap snow; and applications of fertilizer. When fallow is used to carry moisture over to the next season, a cover of crop residue is essential during winter to guard against moisture loss and erosion. Weed control helps to prevent depletion of the moisture supply.

Measures that improve fertility are needed on many soils. Examples are applications of commercial fertilizer, green manure crops, inclusion of legumes in the cropping sequence, and applications of barnyard manure.

Proper management of soils includes measures that maintain good tilth. These measures are especially needed on the soils that have a surface layer of silty clay loam, clay loam, or silty clay. Aberdeen, Great Bend, and Sinai soils are examples. Measures that maintain the content of organic matter are very important if good tilth is to be maintained. The traditional practice of clean-tilled summer fallow contributes to the loss of organic matter because it increases the susceptibility to erosion.

Pasture Groups

The following paragraphs describe the pasture groups in Stutsman County. They specify the production potential under improved management and the representative adapted forage species for each group. The names of the groups are: Clayey, Clayey Subsoil, Claypan, Limy Subirrigated, Loamy and Silty, Overflow and Run-on, Saline, Sands, Sandy, Shallow to Gravel, Thin Claypan, Thin Upland, Very Shallow to Gravel, and Wet.

Clayey pasture group. This group of soils has a relatively high content of clay. The production potential is high. Suitable forage species include smooth bromegrass, Russian wildrye, western wheatgrass, green needlegrass, big bluestem, indiangrass, switchgrass, alfalfa, and sweetclover.

Clayey Subsoil pasture group. This group of soils has a subsoil that somewhat restricts root penetration.

The production potential is moderately high. Suitable forage species include smooth bromegrass, Russian wildrye, western wheatgrass, green needlegrass, switchgrass, alfalfa, and sweetclover.

Claypan pasture group. This group of soils has a dense subsoil that restricts root penetration. The production potential is low. Suitable forage species include western wheatgrass, tall wheatgrass, intermediate wheatgrass, pubescent wheatgrass, slender wheatgrass, alfalfa, and sweetclover.

Limy Subirrigated pasture group. This group of soils has a highly calcareous subsoil. The production potential is high. Suitable forage species include big bluestem, indiangrass, switchgrass, little bluestem, smooth bromegrass, intermediate wheatgrass, pubescent wheatgrass, tall wheatgrass, slender wheatgrass, sweetclover, and birdsfoot trefoil.

Loamy and Silty pasture group. This group of soils has a subsoil that is permeable to roots. The soils have a relatively high content of silt and clay and a low content of sand. The production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, switchgrass, indiangrass, big bluestem, slender wheatgrass, streambank wheatgrass, alfalfa, and sweetclover.

Overflow and Run-on pasture group. This group of soils is in areas that receive additional moisture because of stream overflow or runoff from the surrounding areas. The production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, Russian wildrye, Altai wildrye, western wheatgrass, thickspike wheatgrass, green needlegrass, slender wheatgrass, big bluestem, indiangrass, switchgrass, alfalfa, and sweetclover.

Saline pasture group. This group of soils has enough salts to interfere with plant growth. Wetness is a problem. Severely affected areas can be improved, particularly during the establishment period, by mulch, which reduces the extent of surface drying and improves seedling emergence. The better suited forage species include tall wheatgrass, slender wheatgrass, western wheatgrass, beardless wildrye, alkali sacaton, alsike clover, and sweetclover.

Sands pasture group. This group of soils has a subsoil that is permeable to roots. The soils have a relatively high content of sand and a low content of silt and clay. The production potential is moderately high. Suitable forage species include sand bluestem, prairie sandreed, switchgrass, green needlegrass, intermediate wheatgrass, pubescent wheatgrass, and alfalfa.

Sandy pasture group. This group of soils has a subsoil that is permeable to roots. The soils have a relatively high content of sand and a moderate content of silt and clay. The production potential is high. Suitable forage species include green needlegrass, slender wheatgrass, western wheatgrass, intermediate wheatgrass, pubescent wheatgrass, prairie sandreed, sand bluestem, switchgrass, alfalfa, and sweetclover.

Shallow to Gravel pasture group. This group of soils has a substratum that has a relatively high content of sand or sand and gravel at a depth of about 14 to 25 inches. The production potential is moderate. Drought-tolerant forage species grow best. Suitable species include crested wheatgrass, green needlegrass, western wheatgrass, slender wheatgrass, intermediate wheatgrass, pubescent wheatgrass, and alfalfa.

Thin Claypan pasture group. This group of soils has a very dense subsoil that severely restricts root penetration and has enough salts to interfere with plant growth. The production potential is very low. The best suited forage species include western wheatgrass, slender wheatgrass, and alfalfa.

Thin Upland pasture group. This group of soils is in areas where runoff occurs. The soils have a highly calcareous subsoil. Soil blowing and water erosion are management concerns, particularly during the establishment of seedlings. The production potential is moderate. Suitable forage species include smooth bromegrass, intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, green needlegrass, little bluestem, prairie sandreed, sideoats grama, sweetclover, and alfalfa.

Very Shallow to Gravel pasture group. This group of soils has a substratum that has a high content of sand or sand and gravel within a depth of 14 inches. The production potential is low. The most drought-tolerant forage species grow best. Suitable species include western wheatgrass, crested wheatgrass, green needlegrass, intermediate wheatgrass, and pubescent wheatgrass.

Wet pasture group. This group of soils is wet. The production potential is very high. The best suited forage species are those that are tolerant of wetness and inundation. Suitable species include reed canarygrass,

creeping foxtail, big bluestem, switchgrass, indiangrass, meadow foxtail, and alsike clover.

Management of Saline and Sodic Soils

Saline and sodic soils make up a little more than 5 percent of Stutsman County. Saline soils make up about 3 percent of the county, or 42,000 acres; sodic soils make up 2 percent, or 31,000 acres; and saline-sodic soils make up less than 1 percent, or 4,000 acres.

Saline soils have a high concentration of soluble salts, or salts that dissolve in water. The saline soils in Stutsman County are phases of the Arveson, Colvin, Hamerly, and Vallers series.

Saline soils generally develop in areas of restricted drainage adjacent to natural sloughs and drainageways. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is reduced by plants and a surface cover. The plant roots use the soil water before it can reach the surface and before the salts accumulate. The surface cover prevents evaporation at the surface, the upward movement of water in the soil, and the concentration of salts at the surface.

Plants growing on saline soils absorb salts from the water in the soils. Excess amounts of certain salts may interfere with plant growth. High concentrations of some salts are toxic to certain plants. Some salts cause nutritional imbalances or deficiencies by restricting the uptake or availability of certain plant nutrients. Detecting salinity by visual observations in the field is difficult. The salts are generally not visible during much of the growing season, particularly when the soil is moist. Flecks, threads, or masses of soluble salts are usually visible when the soil is dry. Laboratory analysis is needed to determine the actual degree of salinity in soils.

Crop response, particularly during periods of soil moisture stress, is a useful indicator of the degree of salinity in saline soils. For instance, a small grain crop growing on saline soils tends to be stunted and has fewer tillers than small grain on nonsaline soils. Strongly saline soils are best suited to native grasses or to salt-tolerant introduced grasses. Slightly saline or moderately saline soils can be used for salt-tolerant crops and forage. Barley is the most salt tolerant of the small grains. Of the forage crops, tall wheatgrass, western wheatgrass, and alfalfa are salt tolerant once they are established.

Sodic soils are characterized by a high content of exchangeable sodium, which adheres to the clay particles in the soils. The sodic soils in Stutsman County are those of the Aberdeen, Cavour, Cresbard, and Larson series. Locally, sodic soils are known as "black-alkali," "slick spots," "pan spots," or "gumbo."

Sodic soils develop in a complex pattern with a very distinct microrelief. The physical and chemical properties of these soils differ markedly within very short distances. In many areas the distance between the sodic soils and the surrounding soils that have normal physical properties is only a few feet, perhaps 5 to 10 feet.

Sodic soils develop in areas of saline soils that contain large quantities of sodium salts. Over a long period, usually centuries, rainwater gradually leaches the salts from the surface to the lower horizons as the water table lowers. During this leaching process, the clay in the soils becomes saturated with sodium, disperses, and moves downward with the percolating water. As the moving clay concentrates, a dense, sodic subsoil forms. The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air. Cavour and Larson soils are examples of soils that have a dense, sodic subsoil.

As leaching by water in the soils continues, the sodium is gradually moved lower in the profile and eventually is carried below the rooting depth. The result is a more manageable soil, such as Aberdeen or Cresbard soils. If the leaching process continues and nearly all of the sodium is removed from the profile, the soil eventually changes into a nonsodic soil. This change requires a long period, usually centuries *(6)*.

If plowed, sodic soils are characterized by a surface layer that is sticky when wet and hard and cloddy when dry. A crust forms easily at the surface. The chemical and physical properties of these soils do not favor plant growth. The harmful effects of the properties on plants generally increase as the sodium content increases. The effects of the reduced amount of water available to plants are more harmful than the toxic effect of the sodium. The plants also are affected by depth to the dense subsoil.

Identification of sodic soils in cultivated fields commonly is difficult because many of the physical characteristics, such as columnar structure, have been altered by tillage. Crop response, particularly during periods of moisture stress, is a useful indicator of the level of sodicity in the soil. Crops growing on soils that have varying amounts of sodium exhibit varying heights and stages of development. If the level of sodicity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, the stage of crop growth, and soil moisture. A measure of the effect of sodicity on plant growth is not necessarily a reliable measure of crop yields. In many areas the yields of barley and wheat are affected less than the growth of these crops.

The variability of sodic soils can cause management problems. The sodic soils that have salts within a depth

of 16 inches, such as Miranda soils, are generally best suited to native grasses. The soils that have a dense, sodic subsoil near the surface are generally unsuited to small grain and sunflowers.

Timely tillage is important in areas of the leached sodic soils, such as Aberdeen and Cresbard soils. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soils puddle and crust. If the soils are tilled when too dry, tillage and seeding implements cannot easily penetrate the soils. Deep plowing and chemical amendments can help to reclaim sodic soils, but they may not be feasible. To be effective, deep tillage should reach to the sodic subsoil and mix several inches of the underlying material with the subsoil and topsoil. Depending on the soil, tillage to a depth of 15 to 36 inches may be needed. Any reclamation of sodic soils is a long-term endeavor. Complete reclamation may never be achieved. Onsite investigation is needed to confirm the feasibility of deep tillage in a particular area.

Saline-sodic soils develop in areas of restricted drainage where salts rise with the water table but where some downward leaching of clay and some saturation with sodium are evident and a dense, sodic subsoil has formed. The saline-sodic soils in Stutsman County are those of the Exline and Miranda series. The management needs and crop responses on these soils are a combination of those on saline soils and those on sodic soils.

Additional information about management or reclamation of saline and sodic soils is available from the Natural Resources Conservation Service, the North Dakota Agricultural Experiment Station, and the North Dakota Cooperative Extension Service.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Productivity Index

The productivity index is a relative rating of the ability of a particular map unit to produce a particular crop yield in comparison to other map units. The index ranges from 0, which indicates no yield, to 100, which indicates the highest yield. When the index is calculated, the similar and contrasting inclusions are considered along with the major soils. In Stutsman County a productivity index of 100 was considered equal to an average yield of 40 bushels per acre of spring wheat. Multiplying the productivity index by 40 and then dividing the product by 100 converts the index number to a figure representing the expected average yield per acre. Barnes-Svea loams, 3 to 6 percent slopes, for example, has a productivity index of 81. This number multiplied by 40 and then divided by 100 converts to 32, which is the expected average annual yield of spring wheat in bushels per acre for this map unit (see table 5).

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops *(13)*. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped

at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

This section was prepared by A. Dean Chamrad and Jeffrey L. Printz, range conservationists, Natural Resources Conservation Service

The native vegetation on rangeland consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. Generally, the plants are suitable for grazing and the plant cover is sufficiently productive to justify grazing. Cultural treatments, such as applications of fertilizer and cultivation, generally are not used or needed to maintain the productivity of rangeland. The composition and production of the plant community are largely determined by soil, climate, topography, and grazing management.

In 1990, approximately 338,000 acres in Stutsman County, or about 23 percent of the total acreage, was rangeland. In areas where it is properly managed, this rangeland is similar to the presettlement prairie of the late 1800's and the early 1900's. Most of the rangeland is on loamy glacial till plains and moraines. Much of it occurs as hilly to very steep, well drained or excessively drained soils or as level and nearly level, poorly drained and very poorly drained soils in potholes and depressions. The soils are generally unsuited or at best only poorly suited to cultivated crops.

In 1990, the farms and ranches in the county had about 57,000 head of cattle, including about 4,400 milk cows *(19)*. Most of the ranches are cow-calf enterprises. Some also run stocker yearlings, which add flexibility during periods of low or high forage production. On a few of the farms, raising sheep in conjunction with cattle improves the efficiency of range utilization and results in greater economic stability.

Because of a relatively short growing season, many farmers and ranchers have established cool-season tame pastures to supplement the forage produced on rangeland and to extend the grazing season in the spring and fall. Droughts of short duration are common. They reduce the benefits derived from cool-season pastures in some years. Generally, large quantities of hay and feed are needed because of the long winters. Hay was harvested on about 105,000 acres in the county in 1990 *(19)*.

Range Sites and Condition Classes

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Soils vary in their capacity to produce grasses and other plants suitable for grazing. Soils that produce similar kinds, proportions, and amounts of vegetation are grouped into a range site.

Each range site has a distinctive potential plant community that is referred to as the climax vegetation. The climax vegetation is relatively stable and indicates what the range site is capable of producing. It reproduces itself annually and changes very little as long as the environment remains unchanged. The

climax vegetation on the prairie consists of the kinds of plants that grew when the region was settled. It is generally the most productive combination of plants that can be grown on the site. When the site is improperly grazed, some of the climax plants decrease in quantity, while others increase. Also, plants that were not part of the original native plant community may invade the site.

Decreaser plants are the species that decrease in quantity under heavy, continuous grazing. They generally are the most palatable to livestock.

Increaser plants are the species that initially increase in quantity under heavy, continuous grazing at the expense of the decreaser species. They generally are plants less palatable to livestock than the decreaser species. Under prolonged heavy grazing the increaser plants also eventually decrease in quantity.

Invader plants are species that normally are not part of the climax plant community, because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site only after the extent of the climax vegetation has been reduced by heavy, continuous grazing or other disturbance. Most invader species have limited value as forage. All nonendemic species are invaders in natural plant communities.

Range condition classes indicate the present composition of the plant community on a range site in relation to the climax vegetation. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It is not a rating of forage value. It is expressed as excellent, good, fair, or poor, depending on how closely the present plant community resembles the natural potential plant community. *Excellent* indicates that 76 to 100 percent of the present plant community is the same as the climax vegetation; *good*, 51 to 75 percent; *fair*, 26 to 50 percent; and *poor*, 25 percent or less.

Potential forage production depends on the kind of range site. Current forage production depends on the range condition and the amount of moisture available to the plants during the growing season.

Table 6 shows, for most of the soils in the county, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as rangeland or are suited to rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range sites. Soil reaction, salt content, and a seasonal high water table also are important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. Production is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture or above average temperatures.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as kind of exposure, amount of shade, recent rains, and unseasonably dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. The primary objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush and weeds, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Ecologically sound range management maintains excellent or good range condition. Water is conserved, yields are optimized, and soils are protected. An important management concern is recognizing the changes in the plant community that take place gradually and that can be misinterpreted or overlooked. Growth encouraged by heavy rainfall, for example, may lead to the conclusion that the range is in good condition, when the plant cover actually is weedy and

the long-term trend is toward lower production. On the other hand, some rangeland that has been grazed closely for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover rapidly.

Rangeland can recover from prolonged overuse if the climax decreaser species have not been completely grazed out. If overgrazing is stopped, enough climax plants generally remain for proper grazing use, deferred grazing, and a grazing system to restore the rangeland to excellent condition. In areas where the climax plant community has been destroyed, range seeding can accelerate improvement of the range condition. Seeding the proper climax species also can restore productive rangeland in areas of depleted or low-quality cropland. Brush control, development of water facilities, fences, and other mechanical practices may be needed to facilitate proper grazing management. Proper grazing management is the key to maintaining or improving the productivity and diversity of rangeland.

Range Sites

The following paragraphs describe the range sites in Stutsman County. The names of these sites are Clayey, Claypan, Limy Subirrigated, Overflow, Saline Lowland, Sands, Sandy, Shallow, Shallow to Gravel, Silty, Subirrigated, Thin Claypan, Thin Upland, Very Shallow, Wetland, and Wet Meadow.

Clayey range site. This site is dominated by a mixture of cool-season, mid grasses and an understory of short grasses. The principal species are western wheatgrass, porcupinegrass, needleandthread, and green needlegrass. The understory plants are blue grama, prairie junegrass, Pennsylvania sedge, and other upland sedges. Forbs, such as western yarrow, scarlet globemallow, and green sagewort, make up about 10 percent of the total herbage. The most common woody plants are western snowberry and prairie rose.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, porcupinegrass, green needlegrass, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, needleandthread, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, western ragweed, and fringed sagewort and the invasion of Kentucky bluegrass.

Very few problems affect management of this site. The rate of water infiltration is slow. As a result, an adequate cover of vegetation is needed to help ensure that forage production is not reduced by runoff. Areas where the range is in fair condition can generally be restored to good or excellent condition by proper grazing management if the climax species remain in sufficient numbers and are uniformly distributed.

Claypan range site. The climax vegetation on this site is primarily a mixture of short and mid grasses, sedges, and forbs. The principal species are western wheatgrass, green needlegrass, needleandthread, and prairie junegrass. Other species are blue grama and upland sedges. The most common forbs are scarlet globemallow, silver scurfpea, rush skeletonplant, and fringed sagewort.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and western wheatgrass. The plants that increase in abundance under these conditions are inland saltgrass, blue grama, Sandberg bluegrass, and upland sedges. Further deterioration results in a dominance of blue grama, inland saltgrass, upland sedges, fringed sagewort, broom snakeweed, and annual grasses and forbs.

This site is easily damaged by overgrazing. Because of a dense subsoil and salts in the soils, reestablishing vegetation is difficult in denuded areas. Careful management that maintains an abundance of the naturally dominant plants is the best way to maintain forage production and protect the soil from water erosion.

Limy Subirrigated range site. Tall and mid grasses dominate this site. The principal species are little bluestem, big bluestem, and switchgrass. Other species are indiangrass, slim sedge, fescue sedge, and Baltic rush. Forbs, including Maximilian sunflower, stiff sunflower, American licorice, and Missouri goldenrod, make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, indiangrass, switchgrass, Maximilian sunflower, and stiff sunflower. Little bluestem increases initially in abundance under these conditions, but it eventually decreases. Further deterioration results in a dominance of Baltic rush, common spikerush, and annual grasses and forbs and the invasion of Kentucky bluegrass.

Because of the high percentage of warm-season grasses, this site can provide high-quality forage late in the growing season. In areas where the plant community has deteriorated from its potential, deferment of grazing during the growing season or a planned grazing system and proper grazing use can restore the site. In areas where the potential plant community has been destroyed by cultivation or by

extremely severe overuse, range seeding can reestablish the major species of grasses.

Overflow range site. Both tall and mid grasses are dominant when this site is in excellent condition. The principal species are big bluestem, green needlegrass, western wheatgrass, and needleandthread. Other species are porcupinegrass, prairie dropseed, switchgrass, fescue sedge, and little bluestem. Several forbs, such as Maximilian sunflower, soft goldenrod, cudweed sagewort, and heath aster make up about 10 percent of the total herbage. Several woody plants, such as western snowberry, buffaloberry, and common chokecherry commonly grow on the site, depending on the position on the landscape. They may make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, green needlegrass, prairie dropseed, and switchgrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, Pennsylvania sedge, and fescue sedge. Further deterioration results in a dominance of blue grama, sedges, and unpalatable forbs and the invasion of Kentucky bluegrass.

Because of its position on the landscape, this site is frequently overgrazed. Separate fencing of this site generally is not feasible because of the small size or the shape of areas of the site. Because it is subject to flooding and receives runoff from the adjacent areas, this site is very productive when properly managed. A planned grazing system can help to restore the site and maintain a high level of productivity. Reseeding is needed in areas that have been farmed. In areas where shrubs dominate, brush management can help to restore productivity.

Saline Lowland range site. Salt-tolerant, mid grasses dominate this site. The principal species are Nuttall alkaligrass, inland saltgrass, alkali cordgrass, and other salt-tolerant species, including western wheatgrass and slender wheatgrass. Other species are alkali muhly, plains bluegrass, foxtail barley, and prairie bulrush. Forbs, such as western dock, silverweed cinquefoil, and Pursh seepweed, make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as Nuttall alkaligrass, slender wheatgrass, western wheatgrass, and alkali cordgrass. The plants that increase in abundance under these conditions are inland saltgrass, alkali muhly, foxtail barley, and mat muhly. Further deterioration results in a dominance of inland saltgrass, foxtail barley, silverweed cinquefoil, and western dock.

A high content of salts and a restricted available water capacity limit forage production on this site. Careful management of the adapted, desirable salt-tolerant plants can maintain good forage production. If the plant community has been severely damaged, however, the site recovers slowly. Soil blowing and water erosion are hazards in denuded areas. Livestock ponds on this site frequently contain salty water. If feasible, alternative water sources should be developed.

Sands range site. The principal grasses on this site are prairie sandreed, needleandthread, and sand bluestem. Other species are blue grama, prairie junegrass, sand dropseed, western wheatgrass, and upland sedges. Forbs make up about 10 percent of the total herbage. This site has a small amount of woody species, such as prairie rose, western snowberry, and leadplant amorpha.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie sandreed, little bluestem, sand bluestem, and leadplant amorpha. Needleandthread initially increases in abundance, but it eventually decreases. Other plants that increase in abundance under these conditions are sand dropseed, blue grama, upland sedges, and several forbs. Further deterioration results in a dominance of blue grama, upland sedges, and unpalatable forbs, such as fringed sagewort and cudweed sagewort.

A low or very low available water capacity and the hazard of soil blowing are concerns in managing this site. Measures that minimize the formation of livestock trails and the concentration of livestock are needed. In severely overgrazed areas, blowouts are common. In areas of large blowouts, shaping, seeding, and mulching are needed before the climax vegetation can be reestablished. In areas where the site is in fair or poor condition, the vegetation responds rapidly to improved grazing management.

Sandy range site. The principal grasses on this site are needleandthread, prairie sandreed, blue grama, and western wheatgrass. Other species are prairie junegrass, sand dropseed, green needlegrass, and upland sedges. The site generally has a number of early season forbs, such as western yarrow, green sagewort, and Missouri goldenrod. Woody plants, such as western snowberry and leadplant amorpha, make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, green needlegrass, prairie sandreed, and leadplant amorpha. The plants that increase in abundance under these conditions are blue grama,

upland sedges, sand dropseed, needleandthread, and several forbs. Further deterioration results in a dominance of blue grama, upland sedges, and unpalatable forbs, such as western yarrow, green sagewort, and cudweed sagewort.

A moderate available water capacity is a concern in managing this site. Also, soil blowing is a hazard in denuded areas. Management that maintains an abundance of the key species results in a natural plant community that provides excellent forage for livestock and a protective plant cover.

Shallow range site. The principal grasses on this site are little bluestem, needleandthread, western wheatgrass, plains muhly, blue grama, and sideoats grama. Grasses make up about 75 percent of the total herbage. Upland sedges make up about 10 percent. Forbs, such as blacksamson, hairy goldaster, skeletonweed, purple prairieclover, and stiff sunflower, also make up about 10 percent. Shrubs, such as buffaloberry, western snowberry, and prairie rose, make up the rest.

Continual heavy grazing by cattle results in a decrease in the abundance of little bluestem, needleandthread, prairie sandreed, and stiff sunflower. Needleandthread initially increases in abundance, but it eventually decreases. Other plants that increase in abundance under these conditions are blue grama, upland sedges, red threeawn, and fringed sagewort. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagewort, and unpalatable forbs.

A low available water capacity limits forage production on this site. Water erosion is a hazard in areas that have a slope of more than 5 percent. Gullies form readily along cattle trails and in denuded areas. Management practices that maintain the key plants and control the pattern of livestock traffic help to maintain productivity. Planned grazing systems and proper grazing use help to restore or maintain the productivity of the site.

Shallow to Gravel range site. A mixture of cool- and warm-season grasses dominates this site. The principal species are western wheatgrass, needleandthread, green needlegrass, and blue grama. Other species are plains muhly, prairie junegrass, red threeawn, porcupinegrass, and upland sedges. Forbs make up about 10 percent of the total herbage. The site has only a small amount of woody plants.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, western wheatgrass, plains muhly, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, red threeawn, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagewort, and annual forbs.

A low available water capacity limits forage production on this site. The site is fragile, and the plant community can deteriorate rapidly. Keeping the plant community near its potential and maintaining the vigor of key plants help to optimize the use of the limited amount of available moisture.

Silty range site. Mid grasses dominate this site. The principal species are western wheatgrass, green needlegrass, needleandthread, and blue grama. Other species are prairie junegrass, prairie dropseed, and upland sedges. Forbs include wooly goldenrod, stiff sunflower, and western yarrow. The site has minor amounts of woody species.

Continual heavy grazing by cattle results in a decrease in the abundance of green needlegrass, western wheatgrass, prairie junegrass, and porcupinegrass. The plants that increase in abundance under these conditions are needleandthread, blue grama, threadleaf sedge, needleleaf sedge, and fringed sagewort. Further deterioration results in a dominance of blue grama, threadleaf sedge, needleleaf sedge, fringed sagewort, green sagewort, and other forbs. As the range condition deteriorates, woody species increase in abundance and Kentucky bluegrass invades.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form along livestock trails. Proper grazing use and planned grazing systems help to prevent gullying. Areas where the range is in fair or poor condition generally can be restored to good or excellent condition by sound grazing management. Brush management is needed in areas where undesirable woody species have increased in abundance or invaded.

Subirrigated range site. Tall and mid grasses dominate this site. The principal species are big bluestem, switchgrass, prairie cordgrass, little bluestem, and northern reedgrass. Other species are indiangrass, western wheatgrass, tall dropseed, and slender wheatgrass. The site has minor amounts of sedges and rushes. A variety of forbs makes up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, switchgrass, prairie cordgrass, northern reedgrass, indiangrass, and little bluestem. The plants that increase in abundance under these conditions are mat muhly, fowl bluegrass, Baltic rush, common

spikerush, and various forbs. Further deterioration results in the invasion of Kentucky bluegrass and a dominance of short grasses, grasslike plants, and undesirable forbs.

Because of a high percentage of warm-season grasses, this site can provide high-quality forage late in the growing season. In areas where the plant community has deteriorated from its potential, deferment of grazing during the growing season or a planned grazing system in conjunction with proper grazing use can restore the site. In areas where the potential plant community has been destroyed by cultivation or by extremely severe overuse, range seeding can reestablish the major species of grasses.

Thin Claypan range site. Mid and short grasses dominate this site. The principal species are western wheatgrass, blue grama, inland saltgrass, and Sandberg bluegrass. Other species are prairie junegrass, needleandthread, Nuttall alkaligrass, alkali muhly, and needleleaf sedge. Forbs make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of western wheatgrass, prairie junegrass, and needleandthread. The plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, and alkali muhly. Further deterioration results in a dominance of short grasses, sedges, fringed sagewort, annual forbs, and cactus.

Because of salts near the surface of the soils, productivity is quite low on this site. The site produces good-quality forage for cattle only if properly managed. If the site is in poor or fair condition, recovery is quite slow because of the salts and a dense, sodic subsoil. Livestock ponds should not be constructed on this site because the water is likely to be salty. Sound management can restore the site to good or excellent condition. If the vegetation has been destroyed by cultivation or the site is denuded, range seeding can restore desirable vegetation, but good seeding techniques are essential.

Thin Upland range site. Cool- and warm-season, mid grasses dominate this site. The principal species are little bluestem, needleandthread, western wheatgrass, and sideoats grama. Other species are plains muhly, blue grama, prairie dropseed, bearded wheatgrass, and upland sedges. Forbs include pasqueflower, purple prairie-clover, and dotted gayfeather. The site has minor amounts of woody plants, such as silverberry and western snowberry.

Continual heavy grazing by cattle results in a decrease in the abundance of little bluestem, needleandthread, western wheatgrass, and sideoats grama. The plants that increase in abundance under these conditions are blue grama, red threeawn, upland sedges, and unpalatable forbs. Further deterioration results in a dominance of blue grama, upland sedges, and fringed sagewort; the invasion of Kentucky bluegrass; and an increase of the abundance of woody species.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form along livestock trails. Gullying can be prevented by proper grazing management and by cross-fencing, which helps to control livestock traffic patterns. Soil blowing is a problem in denuded areas. Areas where the range is in fair or poor condition generally can be restored to good or excellent condition by sound grazing management. In some areas brush control is needed.

Very Shallow range site. This site has a mixture of cool- and warm-season, mid and short grasses. The principal species are needleandthread, western wheatgrass, blue grama, and plains muhly. Other species are prairie junegrass, red threeawn, sideoats grama, and upland sedges. Forbs and woody plants make up about 15 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as needleandthread, western wheatgrass, sideoats grama, and plains muhly. The plants that increase in abundance under these conditions are blue grama, red threeawn, sand dropseed, and upland sedges. Further deterioration results in a dominance of blue grama, red threeawn, upland sedges, and undesirable forbs and shrubs.

Available water capacity is very low on this site. Also, water erosion is a hazard in the more sloping areas. Gullies can readily form along cattle trails and in denuded areas. The site is frequently spot grazed. Once it has deteriorated to fair or poor condition, it recovers slowly because of the very low available water capacity. Productivity can be maintained by sound grazing management of the mid grasses.

Wetland range site. Hydrophytic vegetation dominates this site. The principal species are rivergrass, prairie cordgrass, northern reedgrass, slough sedge, and slim sedge. Other species are American mannagrass, American sloughgrass, Baltic rush, and common spikerush. Common forbs are longroot smartweed and waterparsnip. Shrubs generally do not grow on this site.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as rivergrass,

slough sedge, prairie cordgrass, and northern reedgrass. The plants that increase in abundance under these conditions are slim sedge, Baltic rush, common spikesedge, and American sloughgrass. Further deterioration results in a dominance of Baltic rush, common spikesedge, and Mexican dock.

Generally, this site is subject to lighter grazing pressure than the adjacent upland sites. It is more heavily grazed during droughty periods. This site is easily damaged if it is grazed when wet. Grazing during wet periods results in compaction, trampling, and root shearing. A planned grazing system and deferment of grazing when the site is wet helps to maintain the climax vegetation and the important elements of wetland wildlife habitat.

Wet Meadow range site. Sedges and mid grasses dominate this site. The principal species are slim sedge, wooly sedge, fescue sedge, prairie cordgrass, and northern reedgrass. Other species are Baltic rush, common spikerush, fowl bluegrass, and switchgrass. Common forbs are Rydberg sunflower, tall white aster, and common wild mint.

Continual heavy grazing by cattle results in a decrease in the abundance of slim sedge, wooly sedge, northern reedgrass, prairie cordgrass, and switchgrass. The plants that increase in abundance under these conditions are fescue sedge, common spikerush, Baltic rush, mat muhly, and fowl bluegrass. Further deterioration results in a dominance of low-growing sedges, short grasses, western dock, and Canada thistle.

Generally, this site is subject to lighter grazing pressure than the adjacent upland sites. It is more heavily grazed during droughty periods. This site is easily damaged if it is grazed when wet. Grazing during wet periods results in compaction, trampling, and root shearing. A planned grazing system that includes strategic fencing helps to maintain the climax vegetation. The site is an excellent source of quality hay.

Woodland, Windbreaks, and Environmental Plantings

Prepared by Bruce C. Wight, forester, Natural Resources Conservation Service.

Stutsman County has approximately 2,800 acres of native woodland *(8)*. Most of this woodland is concentrated in the James River Valley and along the tributaries of the James River. The trees occur sporadically along the James River and range from areas of a few scattered trees between the reservoirs north of Jamestown to areas of more concentrated bottom land forest south of Jamestown. Woody draws are in areas that drain into the James River. Trees and shrubs are also on the fringe of wetlands throughout the county. The woodland in the woody draws is primarily in areas of Barnes, Buse, and Svea loams. The woodland on the bottom land is mostly in areas of La Prairie silt loam. The woodland on the fringe of the wetlands is mostly in areas of Hamerly loam.

The bottom land forest type consists mainly of American elm, boxelder, and green ash. The less common species include cottonwood, common chokecherry, redosier dogwood, and golden willow. The dominant forest type in the woody draws is green ash. Other trees and shrubs interspersed with the green ash include bur oak, American elm, hackberry, hawthorn, American plum, chokecherry, juneberry, Wood's rose, snowberry, serviceberry, silver buffaloberry, and redosier dogwood. Shrubs are dominant in the upper reaches of the woody draws. The principal species on the wooded fringe of the wetlands are quaking aspen, various willow species, and redosier dogwood.

The early settlers used the trees for fuel, lumber, and fenceposts. Currently, there is a renewed interest in using the trees for fuel, but the principal uses are for protection and esthetic purposes. The trees protect the soils, homes, livestock, wildlife, and watersheds.

Windbreaks have been planted in Stutsman County since the early days of settlement. Some of these early plantings were made under the Timber Culture Act. Under this act, 160 acres of land was granted to a homesteader who planted 10 acres to trees. Most of the early plantings were made to protect farmsteads and livestock. In the 1930's, approximately 2,250 acres was planted to trees and shrubs under the Prairie States Forestry Project of the U.S. Department of Agriculture, Forest Service.

Since the 1930's, more than 6,000,000 trees have been planted on about 9,500 acres by county farmers and landowners assisted by the Natural Resources Conservation Service and the Stutsman County Soil Conservation District. Trees and shrubs are still needed around numerous farmsteads in the county, but the major need is for windbreaks that help to protect soils that are highly susceptible to soil blowing.

The following items should be considered before a planting is made—the purpose of the planting, the suitability of various species of trees and shrubs to the soils and the climate, the location and design of the windbreak, and the selection of hardy seedlings. If these items are not considered, a poor or unsuccessful windbreak may result.

The establishment of a windbreak or an environmental planting and the growth of the trees and shrubs also depend on suitable site preparation and adequate maintenance after the trees and shrubs are

planted. Grasses and weeds should be eliminated before the trees and shrubs are planted and the competing ground cover should be controlled for the life of the windbreak. Some replanting may be necessary during the first 2 years after the trees and shrubs are planted.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Prepared by David D. Dewald, biologist, Natural Resources Conservation Service.

The recreational resources of Stutsman County are somewhat limited. Hunting and fishing are the main recreational opportunities available to the residents of the county. Opportunities for fishing and limited primitive camping are available at Round Lake, Barnes Lake, Pipestem Dam, Jamestown Reservoir, Jim Lake, Spiritwood Lake, Crystal Springs, Hehn-Shaffer Pond, and Lehr Dam. Northern pike, bullhead, walleyed pike, crappie, bluegill, smallmouth bass, muskie, and perch are the main species of game fish in the waters.

The county has areas for picnicking and limited camping in 11 towns. It has no State or county parks.

Approximately 39,000 acres managed by the U.S. Fish and Wildlife Service provides opportunities for hunting. The North Dakota State Game and Fish Department manages approximately 150 acres of wildlife areas. About 15,200 acres of State school land is open to the public. Many private landowners grant permission to hunt on their land.

The public areas in the county provide opportunities for numerous recreational activities, including hiking, bird-watching, and cross-country skiing.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet,

are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Prepared by David D. Dewald, biologist, Natural Resources Conservation Service.

Stutsman County is in the prairie pothole region of North Dakota. It has diverse kinds of wildlife habitat. Since settlement, agricultural activity has reduced the quality and quantity of rangeland and wetland wildlife habitat but has increased the amount of openland wildlife habitat. About 20 percent of the original rangeland habitat remains. The diversity of the wildlife habitat is enhanced by the numerous wetlands in the county. Drainage systems installed to improve crop production have removed approximately 50 percent of the original wetland habitat. The remaining wetlands provide habitat for waterfowl and furbearers.

Private landowners have planted more than 9,000 acres of field and farmstead windbreaks, which provide habitat for resident and migratory wildlife species. Also, private landowners have protected approximately 39,000 acres of wetlands by conveying their drainage rights to the Federal Government through the Small Wetlands Acquisition Program. Private landowners manage additional areas of upland and wetland primarily for wildlife. The expanded use of no-till farming and other conservation tillage systems and the inclusion of grasses and legumes in the cropping system have increased the amount of food and cover for migratory waterfowl and resident wildlife.

The public lands in Stutsman County provide excellent wildlife habitat. The U.S. Fish and Wildlife Service manages about 23,300 acres as waterfowl production areas and an additional 18,300 acres as easement refuges. The North Dakota State Game and Fish Department manages approximately 150 acres of wildlife areas.

Important game bird species in the county are gray partridge, ring-necked pheasant, ducks, geese, mourning dove, sharp-tailed grouse, and sandhill crane. The mammals that are hunted in the county include red fox, coyote, white-tailed deer, muskrat, mink, raccoon, badger, cottontail rabbit, and white-tailed jackrabbit.

A variety of fish species inhabits the waters in the county. Northern pike, perch, walleyed pike, crappie, bluegill, smallmouth bass, muskie, and bullhead are the major species. Most of the fish are in public waters. The potential for developing additional fishery resources is limited.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and

features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, tall wheatgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, western wheatgrass, and blue grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are common chokecherry, buffaloberry, snowberry, and juneberry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, common reedgrass, saltgrass, prairie cordgrass, bulrushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include gray partridge, pheasant, western meadowlark, lark bunting, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, sharp-tailed grouse, western meadowlark, and david's sparrow.

About 167,000 acres in Stutsman County, or nearly 12 percent of the total acreage, meets the requirements for hydric soils. The map units in the survey area that display hydric characteristics are listed in this section. Areas that have been artificially drained or otherwise so altered that they no longer support a predominance of hydrophytic vegetation are not identified as hydric soils on the soil maps. The list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4, and the location of each is shown on the detailed maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

1	Southam silty clay loam
2	Parnell silty clay loam
3	Tonka silt loam
4	Hamerly-Parnell complex, 0 to 3 percent slopes (Parnell part)
5	Hamerly-Tonka complex, 0 to 3 percent slopes (Tonka part)
13	Hamerly, Vallers, and Colvin soils, saline, 0 to 3 percent slopes (Vallers and Colvin parts)
25E	Barnes-Buse-Parnell complex, 0 to 35 percent slopes (Parnell part)
40	Divide-Marysland loams, 0 to 3 percent slopes (Marysland part)
50	Fossum fine sandy loam
51	Arveson loam, saline
70	Colvin silty clay loam, wet
72	Minnewaukan loamy sand, loamy substratum, 0 to 3 percent slopes
76	Fargo-Colvin silty clay loams
77	Colvin silty clay loam
88C	Seelyeville mucky peat, 0 to 9 percent slopes
90	Lamoure silty clay loam
92	La Prairie and Lamoure soils, channeled (Lamoure part)

Engineering

This section provides information for planning land uses related to urban development and to water

management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping

and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils.

Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40

inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a

combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-

weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-

thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the North Dakota State Highway Department Laboratory.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 422 (ASTM) D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); and Moisture density, T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(14)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that has a frigid temperature regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Udic* identifies the subgroup that has a Udic moisture regime. An example is Udic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, Udic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(16)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(14)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aberdeen Series

The Aberdeen series consists of very deep, moderately well drained, slowly permeable, sodic soils on lake plains. These soils formed in glaciolacustrine deposits. Slope is 0 to 1 percent.

Typical pedon of Aberdeen silty clay loam, 85 feet east and 150 feet north of the southwest corner of sec. 33, T. 139 N., R. 67 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; neutral; abrupt smooth boundary.

A—7 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate medium granular; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; neutral; abrupt smooth boundary.

BE—12 to 15 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to weak fine platy; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; clear sand grains on faces of peds (E); neutral; abrupt smooth boundary.

Btn1—15 to 24 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine angular blocky; very hard and firm; very sticky and plastic; common very fine roots; clear sand grains on faces of peds; common faint black (10YR 2/1) clay films on faces of peds; neutral; clear smooth boundary.

Btn2—24 to 31 inches; very dark gray (10YR 3/1) silty clay, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate fine angular and subangular blocky; very hard and firm; very sticky and plastic; few very fine roots; common faint black (10YR 2/1) clay films on faces of peds; few salt crystals; slightly alkaline; clear smooth boundary.

Bkz—31 to 44 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; few fine faint light olive brown (2.5Y 5/3) mottles; moderate medium prismatic structure parting to weak fine subangular blocky; hard and firm; sticky and plastic; common salt crystals; common medium rounded soft masses of lime; few fine concretions of manganese oxide; strong effervescence; moderately alkaline; clear smooth boundary.

C—44 to 60 inches; olive (5Y 5/3) silty clay loam, pale olive (5Y 6/3) dry; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few medium rounded soft masses of lime; common fine concretions of manganese and iron oxide; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 16 to 40 inches. The A horizon has value of 2 or 3 (3 or 4 dry). The BE horizon has value of 3 or 4 (4 or 5 dry) and chroma of 1 or 2. The Btn horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It is silty clay, silty clay loam, or clay. The Bkz horizon has hue of 2.5Y or 5Y, value of 3 to 5 (5 to 7 dry), and chroma of 1 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 8 dry), and chroma of 2 to 4. It is silt loam or silty clay loam.

Arveson Series

The Arveson series consists of very deep, poorly drained, moderately permeable, highly calcareous, saline soils on lake plains and outwash plains. These soils formed in glaciofluvial and glaciolacustrine deposits. Slope is 0 to 1 percent.

Typical pedon of Arveson loam, saline, 150 feet north and 700 feet east of the southwest corner of sec. 11, T. 140 N., R. 65 W.

Az—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; common salt crystals; slight effervescence; slightly alkaline; clear wavy boundary.

Bkg1—10 to 18 inches; gray (5Y 5/1) loam, light gray (5Y 7/1) dry; weak medium prismatic structure parting to weak fine and medium granular; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; few salt crystals; lime disseminated throughout; violent effervescence; moderately alkaline; clear irregular boundary.

Bkg2—18 to 24 inches; gray (5Y 5/1) loam, light gray (5Y 6/1) dry; many fine prominent yellowish brown (10YR 5/8) and common fine distinct grayish brown (2.5Y 5/2) mottles; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; few salt crystals; lime disseminated throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Cg1—24 to 42 inches; gray (5Y 5/1) fine sandy loam, light gray (5Y 6/1) dry; common fine prominent light olive brown (2.5Y 5/4) mottles; massive; soft and very friable; slightly sticky and slightly plastic; few fine dark concretions of manganese oxide; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cg2—42 to 60 inches; gray (5Y 5/1) fine sandy loam, light gray (5Y 7/1) dry; many fine and medium prominent light olive brown (2.5Y 5/6) and few fine

prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few fine concretions of manganese oxide; slight effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 7 to 24 inches. The A horizon has hue of 10YR to 5Y and value of 2 or 3 (3 or 4 dry). The Bkg horizon has hue of 2.5Y or 5Y, value of 3 to 7 (4 to 8 dry), and chroma of 1 or 2. It is loam or sandy loam. The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 1 or 2. It is dominantly fine sandy loam, sandy loam, loamy sand, or sand. In some pedons it is clay loam below a depth of 40 inches.

Arvilla Series

The Arvilla series consists of very deep, somewhat excessively drained soils on outwash plains. These soils formed in glaciofluvial deposits. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slope ranges from 0 to 25 percent.

Typical pedon of Arvilla sandy loam, in an area of Arvilla-Sioux sandy loams, 0 to 3 percent slopes; 2,585 feet east and 45 feet south of the northwest corner of sec. 7, T. 142 N., R. 69 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate medium granular; soft and very friable; slightly sticky and slightly plastic; many fine and medium roots; about 3 percent gravel; neutral; abrupt smooth boundary.

Bw—8 to 18 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; soft and very friable; slightly sticky and slightly plastic; many very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

2C—18 to 60 inches; dark brown (10YR 3/3) gravelly sand, brown (10YR 5/3) dry; single grain; loose; nonsticky and nonplastic; few coatings of lime on individual pebbles in the upper part; about 20 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 8 to 20 inches. The depth to sand and gravel ranges from 14 to 25 inches. The content of gravel in the 2C horizon ranges from 5 to 35 percent.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 7.5YR, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3.

The Arvilla soils in detailed soil map units 44 and 44C have a thicker mollic epipedon and slightly more clay than is definitive for the series. These differences, however, do not affect the use and management of the soils.

Barnes Series

The Barnes series consists of very deep, well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 0 to 25 percent.

Typical pedon of Barnes loam, in an area of Svea-Barnes loams, 0 to 3 percent slopes; 1,430 feet south and 1,090 feet east of the northwest corner of sec. 5, T. 144 N., R. 64 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate medium granular; slightly hard and friable; slightly sticky and slightly plastic; common or many very fine and fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

Bw—7 to 12 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common or many very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bk—12 to 29 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 5 percent gravel; many fine and medium irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—29 to 60 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; few fine prominent red (2.5YR 4/8) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; about 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The A horizon has value of 2 or 3 (3 or 4 dry). It generally has chroma of 1, but some pedons have chroma of 2 below the Ap horizon. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 5 (3 to 6 dry), and chroma of 2 to 4. The Bk horizon has hue of 2.5Y or 10YR, value of 4 to 6 (5 to 8 dry), and chroma of 2 to 4.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (4 to 7 dry), and chroma of 2 to 4. The Bw and C horizons are loam or clay loam.

Bearden Series

The Bearden series consists of very deep, somewhat poorly drained, moderately slowly permeable, highly calcareous soils on lake plains. These soils formed in glaciolacustrine deposits. Slope is 0 to 1 percent.

Typical pedon of Bearden silty clay loam, in an area of Overly-Bearden silty clay loams, 0 to 3 percent slopes; 170 feet south and 420 feet east of the northwest corner of sec. 21, T. 139 N., R. 67 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 19 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; few fine faint grayish brown (2.5Y 5/2) mottles; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; black (10YR 2/1) A horizon material filling root channels; lime disseminated throughout; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—19 to 27 inches; light olive brown (2.5Y 5/4) silty clay loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; lime disseminated throughout and in common fine rounded soft masses; violent effervescence; moderately alkaline; clear smooth boundary.

Bky—27 to 37 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct grayish brown (2.5Y 5/2) and dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many fine nests of gypsum crystals; lime disseminated throughout and in common fine rounded soft masses; violent effervescence; moderately alkaline; clear smooth boundary.

Cg1—37 to 54 inches; olive gray (5Y 5/2) silt loam, light gray (5Y 7/2) dry; few fine prominent dark brown (7.5YR 3/4) and common medium prominent dark yellowish brown (10YR 4/4) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few fine concretions of iron oxide; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg2—54 to 60 inches; olive gray (5Y 5/2) loam, light olive gray (5Y 6/2) dry; common fine prominent olive brown (2.5Y 4/4) mottles; massive; soft and very friable; slightly sticky and slightly plastic; few fine concretions of iron oxide; strong effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 to 5 dry). The Bk horizon has hue of 10YR to 5Y, value of 3 to 5 (5 to 7 dry), and chroma of 1 to 4. The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is silt loam, loam, or silty clay loam.

Buse Series

The Buse series consists of very deep, well drained, moderately slowly permeable soils on till plains and moraines and in stream valleys. These soils formed in glacial till. Slope ranges from 3 to 50 percent.

Typical pedon of Buse loam, in an area of Buse-Svea loams, 15 to 50 percent slopes; 2,055 feet south and 795 feet east of the northwest corner of sec. 6, T. 143 N., R. 64 W.

A—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bk1—7 to 17 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; moderate medium prismatic structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; about 5 percent gravel; common fine irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk2—17 to 36 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; weak medium prismatic structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; about 5 percent gravel; many fine irregularly shaped soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; few fine prominent dark red (2.5YR 3/6) and few medium prominent yellowish red (5YR 4/6) relict mottles; massive; slightly hard and friable; slightly sticky and slightly

plastic; about 5 percent gravel; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 10 inches. The depth to carbonates ranges from 0 to 7 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). The Bk horizon has hue of 10YR or 2.5Y and value of 4 to 6 (4 to 7 dry). The Bk and C horizons are clay loam or loam. The C horizon has hue of 10YR to 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4.

Cavour Series

The Cavour series consists of very deep, moderately well drained, slowly permeable, sodic soils on till plains. These soils formed in glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Cavour loam, in an area of Cresbard-Cavour loams, 0 to 3 percent slopes; 1,520 feet south and 700 feet east of the northwest corner of sec. 4, T. 144 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

A—7 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; about 5 percent gravel; neutral; abrupt wavy boundary.

E—9 to 11 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak to moderate thin and medium platy structure; soft and very friable; nonsticky and nonplastic; common very fine and fine roots; about 5 percent gravel; neutral; gradual wavy boundary.

Btn1—11 to 21 inches; black (10YR 2/1) and very dark brown (10YR 2/2) silty clay, very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) dry; strong coarse columnar structure; very hard and very firm; sticky and plastic; few very fine roots; many distinct very dark gray (10YR 3/1) coatings of silt on tops of columns; common distinct very dark brown (10YR 2/2) clay films on faces of peds; about 5 percent gravel; neutral; gradual wavy boundary.

Btn2—21 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; common fine prominent strong brown (7.5YR 5/6) mottles; strong medium prismatic structure parting to strong medium angular blocky; very hard and very firm; sticky and plastic; few very fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; few nests of gypsum and other salts in the lower part; about 5 percent gravel; neutral; gradual wavy boundary.

Bkyz—30 to 42 inches; grayish brown (2.5Y 5/2) clay loam, light brownish gray (2.5Y 6/2) dry; common medium distinct light yellowish brown (2.5Y 6/4) and common medium prominent dark gray (N 4/0) mottles; strong medium prismatic structure parting to strong fine angular blocky; very hard and very firm; sticky and plastic; few very fine roots; many fine and medium irregularly shaped soft masses of lime; common nests of gypsum and other salts; about 5 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

Byz—42 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (2.5Y 5/2) dry; common medium distinct olive brown (2.5Y 4/4) and prominent gray (N 5/0) mottles; massive; very hard and very firm; sticky and plastic; common nests of gypsum and other salts; about 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 35 inches. The depth to carbonates ranges from 14 to 35 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). The E horizon has value of 2 to 5 (3 to 7 dry) and chroma of 1 or 2. The Btn horizon has chroma of 1 to 3. It is clay loam, silty clay, or clay. The Bkyz and Byz horizons have hue of 2.5Y or 5Y, value of 5 to 7 dry, and chroma of 1 to 4. They are loam or clay loam.

Clontarf Series

The Clontarf series consists of very deep, well drained, moderately rapidly permeable soils on outwash plains. These soils formed in glaciofluvial deposits. Slope ranges from 0 to 6 percent.

Typical pedon of Clontarf fine sandy loam, 0 to 6 percent slopes, 450 feet north and 1,100 feet west of the southeast corner of sec. 31, T. 141 N., R. 68 W.

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft and very friable; slightly sticky and slightly plastic; common very fine roots; neutral; abrupt smooth boundary.

A—7 to 17 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; soft and very friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

Bw—17 to 25 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak fine and medium subangular blocky; soft and very friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

2BC—25 to 31 inches; dark brown (10YR 4/3) loamy sand, brown (10YR 5/3) dry; weak medium subangular blocky structure; soft and very friable; slightly sticky and nonplastic; few very fine roots; neutral; clear wavy boundary.

2C1—31 to 50 inches; olive brown (2.5Y 4/4) sand, light olive brown (2.5Y 5/4) dry; few fine distinct dark grayish brown (2.5Y 4/2) mottles; single grain; loose; nonsticky and nonplastic; neutral; gradual wavy boundary.

2C2—50 to 60 inches; olive brown (2.5Y 4/4) fine sand, light yellowish brown (2.5Y 6/4) dry; common medium distinct olive yellow (2.5Y 6/6) and few fine prominent strong brown (7.5YR 5/6) mottles; single grain; loose; nonsticky and nonplastic; strong effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 16 to 34 inches. The depth to carbonates ranges from 40 to more than 60 inches. The thickness of the loamy upper part of the profile ranges from 20 to 36 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3. It is sandy loam, fine sandy loam, or loam. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 6. It is sand, fine sand, loamy sand, or loamy fine sand.

Colvin Series

The Colvin series consists of very deep, poorly drained and very poorly drained, moderately slowly permeable, highly calcareous soils on lake plains and in channels. These soils formed in glaciolacustrine deposits and alluvium. Slope is 0 to 1 percent.

Typical pedon of Colvin silty clay loam, in an area of Hamerly, Vallers, and Colvin soils, saline, 0 to 3 percent slopes; 1,055 feet south and 2,205 feet west of the northeast corner of sec. 2, T. 142 N., R. 63 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; few fine salt crystals; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bkz—7 to 14 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; common fine prominent gray (5Y 5/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common salt crystals; lime disseminated throughout; violent effervescence; moderately alkaline; clear irregular boundary.

Bky—14 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (2.5Y 7/2) dry; common fine and medium distinct light yellowish brown (2.5Y 6/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; hard and firm; sticky and plastic; common nests of gypsum; lime disseminated throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Cg1—30 to 40 inches; gray (5Y 6/1) silty clay loam, light gray (5Y 7/1) dry; many large prominent brownish yellow (10YR 6/8) mottles; massive; very hard and firm; sticky and plastic; lime disseminated throughout; slight effervescence; moderately alkaline; clear wavy boundary.

Cg2—40 to 48 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; common medium distinct gray (5Y 6/1) and few fine prominent dark reddish brown (5YR 3/4) mottles; massive; very hard and firm; sticky and plastic; lime disseminated throughout; slight effervescence; moderately alkaline; clear wavy boundary.

Cg3—48 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; common medium prominent yellowish red (5YR 4/6) mottles; massive; very hard and firm; sticky and plastic; lime disseminated throughout; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. Some pedons are nonsaline.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1, or it is neutral in hue. The Bk horizon has hue of 10YR to 5Y and value of 4 to 6 (5 to 8 dry). The Cg horizon has value of 4 to 6 (5 to 7 dry) and chroma of 1 to 3.

Cresbard Series

The Cresbard series consists of very deep, moderately well drained, slowly permeable, sodic soils on till plains. These soils formed in glacial till. Slope ranges from 0 to 6 percent.

Typical pedon of Cresbard loam, in an area of Svea-Cresbard loams, 0 to 3 percent slopes; 90 feet south and 1,500 feet west of the northeast corner of sec. 25, T. 143 N., R. 64 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium granular

structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

E—7 to 9 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; moderate thin platy structure; slightly hard and very friable; slightly sticky and slightly plastic; common very fine roots; about 3 percent gravel; neutral; clear wavy boundary.

B/E—9 to 14 inches; very dark grayish brown (10YR 3/2) clay loam, dark gray (10YR 4/1) (B) and grayish brown (10YR 5/2) (E) dry; moderate fine angular blocky structure; very hard and firm; slightly sticky and slightly plastic; common very fine roots; about 3 percent gravel; neutral; clear wavy boundary.

Btn1—14 to 19 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; weak fine prismatic structure parting to strong fine angular blocky; very hard and firm; sticky and plastic; common very fine roots; common distinct black (10YR 2/1) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Btn2—19 to 22 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to strong medium angular blocky; very hard and firm; sticky and plastic; few very fine roots; few distinct very dark brown (10YR 2/2) clay films on faces of peds; about 3 percent gravel; moderately alkaline; gradual wavy boundary.

Bk—22 to 28 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure; slightly hard and friable; slightly sticky and slightly plastic; many coarse irregularly shaped soft masses of lime; about 5 percent gravel; violent effervescence; moderately alkaline; clear wavy boundary.

C—28 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent yellowish red (5YR 4/6) and few fine distinct light brownish gray (2.5Y 6/2) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; about 5 percent gravel; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 15 to 40 inches. The A horizon has value of 2 or 3 (3 or 4 dry). The E horizon has value of 2 to 4 (5 or 6 dry) and chroma of 1 or 2. The Btn horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 6 dry), and chroma of 1 to 3. It is clay loam, silty clay, or clay. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is clay loam or loam.

Darnen Series

The Darnen series consists of very deep, well drained, moderately permeable soils in stream valleys. These soils formed in colluvium and alluvium. Slope ranges from 0 to 6 percent.

Typical pedon of Darnen loam, 0 to 3 percent slopes, 1,760 feet south and 2,500 feet east of the northwest corner of sec. 12, T. 143 N., R. 65 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; neutral; abrupt smooth boundary.

A—6 to 18 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; neutral; clear wavy boundary.

Bw1—18 to 28 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; sticky and plastic; few very fine roots; neutral; gradual wavy boundary.

Bw2—28 to 32 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; sticky and plastic; neutral; gradual wavy boundary.

C—32 to 60 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; common fine irregularly shaped soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 48 inches. The depth to carbonates ranges from 20 to 40 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has value of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. The Bw and C horizons are loam or clay loam. The C horizon has value of 4 to 6 and chroma of 2 to 6.

Divide Series

The Divide series consists of very deep, somewhat poorly drained, highly calcareous soils on outwash

plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 3 percent.

Typical pedon of Divide loam, in an area of Divide-Marysland loams, 0 to 3 percent slopes; 125 feet west and 1,525 feet north of the southeast corner of sec. 30, T. 143 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak medium granular; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and fine roots; about 5 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—7 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; hard and friable; slightly sticky and slightly plastic; common very fine roots; about 5 percent gravel; strong effervescence; moderately alkaline; abrupt wavy boundary.

Bk1—10 to 16 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard and friable; slightly sticky and slightly plastic; common very fine roots; common fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk2—16 to 22 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; common fine distinct olive yellow (2.5Y 6/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard and friable; slightly sticky and slightly plastic; few very fine roots; common medium soft masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

2C1—22 to 55 inches; olive brown (2.5Y 4/4) sand, light olive brown (2.5Y 5/4) dry; single grain; loose; nonsticky and nonplastic; about 5 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

2C2—55 to 60 inches; grayish brown (2.5Y 5/2) gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; about 20 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. The depth to sand and gravel ranges from 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 to 5 dry). The Bk horizon has hue of 10YR or 2.5Y, value of 3 to 6 (5 to 8 dry), and chroma of 1 to 4. It is loam or clay loam. The 2C horizon has hue of 10YR to 5Y, value of 5 to 7 dry, and chroma of 2 to 6.

Embden Series

The Embden series consists of very deep, moderately well drained, moderately rapidly permeable soils on lake plains and outwash plains. These soils formed in glaciolacustrine and glaciofluvial deposits. Slope ranges from 0 to 6 percent.

Typical pedon of Embden fine sandy loam, 0 to 6 percent slopes, 2,600 feet south and 1,000 feet east of the northwest corner of sec. 2, T. 143 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

A—7 to 18 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard and friable; slightly sticky and nonplastic; many fine roots; neutral; gradual wavy boundary.

Bw1—18 to 24 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and nonplastic; common fine roots; neutral; gradual wavy boundary.

Bw2—24 to 32 inches; dark brown (10YR 3/3) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and nonplastic; few fine roots; neutral; gradual wavy boundary.

C1—32 to 48 inches; dark brown (10YR 4/3) fine sandy loam, grayish brown (10YR 5/2) dry; massive; hard and friable; slightly sticky and nonplastic; few fine roots; neutral; gradual wavy boundary.

C2—48 to 60 inches; dark yellowish brown (10YR 4/4) fine sandy loam, pale brown (10YR 6/3) dry; massive; hard and friable; slightly sticky and slightly plastic; slight effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 16 to 36 inches. The depth to carbonates ranges from 20 to 54 inches.

The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3. The Bw and C horizons are fine sandy loam or sandy loam. The C horizon has hue of 10YR or 2.5Y and value of 4 to 6 (5 to 7 dry).

Exline Series

The Exline series consists of very deep, somewhat poorly drained, very slowly permeable, sodic, saline soils on lake plains and in channels. These soils formed in glaciolacustrine deposits and alluvium. Slope is 0 to 1 percent.

Typical pedon of Exline silt loam, 165 feet west and 240 feet north of the southeast corner of sec. 36, T. 144 N., R. 67 W.

E—0 to 1 inch; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; neutral; abrupt smooth boundary.

Btn—1 to 5 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium angular blocky; extremely hard and very firm; sticky and plastic; common fine and few medium roots; common distinct black (10YR 2/1) clay films on faces of peds; slightly alkaline; clear smooth boundary.

Btnz—5 to 10 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard and very firm; sticky and plastic; common fine and few medium roots; common distinct black (10YR 2/1) clay films on faces of peds; common salt crystals; slightly alkaline; clear wavy boundary.

Bk—10 to 28 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; hard and firm; sticky and plastic; lime disseminated throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C—28 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; massive; hard and firm; sticky and plastic; lime disseminated throughout; slight effervescence; slightly alkaline.

The depth to gypsum and other salts ranges from 6 to 16 inches. The depth to carbonates ranges from 8 to 19 inches.

Some pedons have an A horizon. The E horizon has value of 3 to 5 (5 or 6 dry). The Btn and Btnz horizons have hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. The Btn, Btnz, and Bk horizons are clay loam, silty clay, clay, or silty clay loam. The Bk horizon has hue of 10YR or 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 1 to 3. Some pedons do not have a Bk horizon. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7 (5 to 8 dry), and chroma of 2 to 4. It is silty clay, silty clay loam, or silt loam.

Fargo Series

The Fargo series consists of very deep, poorly drained, slowly permeable soils on lake plains. These soils formed in glaciolacustrine deposits. Slope is 0 to 1 percent.

Typical pedon of Fargo silty clay loam, in an area of Fargo-Colvin silty clay loams; 815 feet south and 315 feet east of the northwest corner of sec. 29, T. 139 N., R. 67 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and medium roots; neutral; abrupt smooth boundary.

A—7 to 11 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; hard and firm; sticky and plastic; common fine and medium roots; neutral; abrupt wavy boundary.

Bw1—11 to 15 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very hard and firm; sticky and plastic; few fine and medium roots; black (10YR 2/1) coatings on faces of peds; cracks filled with A horizon material extend throughout; neutral; clear smooth boundary.

Bw2—15 to 19 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard and firm; sticky and plastic; few fine roots; very dark gray (10YR 3/1) coatings on faces of peds; cracks filled with A horizon material extend throughout; slight effervescence; slightly alkaline; clear smooth boundary.

Bk—19 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few fine prominent dark yellowish brown (10YR 4/4) mottles; moderate coarse prismatic structure; hard and firm; sticky and plastic; few fine roots; few very dark gray (10YR 3/1) coatings on faces of peds; lime disseminated throughout; strong effervescence; moderately alkaline; clear smooth boundary.

C—29 to 60 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; few fine prominent dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; massive; hard and firm; sticky and plastic; few fine roots; lime disseminated throughout; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 8 to 24 inches. The depth to carbonates ranges from 11 to 25 inches.

The A horizon has hue of 10YR to 5Y. The Bw horizon has hue of 10YR to 5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. The Bw and Bk horizons are silty clay loam, silty clay, or clay. The Bk horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 8 dry), and chroma of 1 to 3. It is silty clay loam or silty clay.

Fordville Series

The Fordville series consists of very deep, well drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 6 percent.

Typical pedon of Fordville loam, in an area of Fordville-Renshaw loams, 0 to 3 percent slopes; 2,020 feet north and 965 feet west of the southeast corner of sec. 30, T. 143 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; many fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

A—7 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bw1—11 to 21 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 5 percent gravel; neutral; gradual wavy boundary.

Bw2—21 to 27 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 5 percent gravel; neutral; gradual wavy boundary.

BC—27 to 32 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; moderate medium prismatic structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 5 percent gravel; neutral; gradual wavy boundary.

2C—32 to 60 inches; yellowish brown (10YR 5/4) gravelly sand, light yellowish brown (10YR 6/4) dry; single grain; loose; nonsticky and nonplastic; about 20 percent gravel; strong effervescence; moderately alkaline.

The depth to sand and gravel ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 16 to 30 inches. The content of gravel in the 2C horizon ranges from 5 to 50 percent.

The A horizon has value of 2 or 3. The Bw horizon has value of 2 to 4 (3 to 5 dry) and chroma of 2 to 4. It is loam or clay loam. The BC horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 2 or 3. It is loam, clay loam, or sandy clay loam. Some pedons have a Bk horizon. This horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 2 or 3. It is loam, clay loam, or sandy clay loam. The 2C horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 2 to 4. It is loamy sand, sand, or gravelly sand.

Fossum Series

The Fossum series consists of very deep, poorly drained, rapidly permeable, calcareous soils on lake plains and outwash plains. These soils formed in glaciolacustrine and glaciofluvial deposits. Slope is 0 to 1 percent.

Typical pedon of Fossum fine sandy loam, 205 feet east and 2,300 feet north of the southwest corner of sec. 20, T. 144 N., R. 65 W.

A1—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; slightly hard and friable; nonsticky and nonplastic; many fine and medium roots; slight effervescence; slightly alkaline; clear smooth boundary.

A2—8 to 17 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard and very friable; nonsticky and nonplastic; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

Bk—17 to 30 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; few fine distinct olive yellow (2.5Y 6/6) mottles; single grain; loose; nonsticky and nonplastic; few fine roots; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C—30 to 60 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; common fine distinct olive yellow (2.5Y 6/6) mottles; single grain; loose; nonsticky and nonplastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 1 or 2. It is fine sand, sand, loamy sand, or loamy fine sand. Some pedons have a 2C horizon of loam or clay loam below a depth of 40 inches.

Great Bend Series

The Great Bend series consists of very deep, well drained, moderately slowly permeable soils on lake plains. These soils formed in glaciolacustrine deposits. Slope ranges from 3 to 6 percent.

Typical pedon of Great Bend silty clay loam, in an area of Great Bend-Overly silty clay loams, 3 to 6 percent slopes; 890 feet east and 2,070 feet south of the northwest corner of sec. 25, T. 139 N., R. 67 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; neutral; abrupt smooth boundary.

Bw—7 to 13 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; few fine distinct grayish brown (2.5Y 5/2) relict mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; neutral; clear smooth boundary.

Bk—13 to 20 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct grayish brown (2.5Y 5/2) and few fine distinct dark yellowish brown (10YR 4/4) relict mottles; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; common threadlike accumulations of lime; violent effervescence; moderately alkaline; clear smooth boundary.

C1—20 to 30 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct grayish brown (2.5Y 5/2) and few fine prominent yellowish brown (10YR 5/6) relict mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; common threadlike accumulations of lime; violent effervescence; moderately alkaline; clear smooth boundary.

C2—30 to 55 inches; grayish brown (2.5Y 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; common fine distinct light olive brown (2.5Y 5/4) and few fine distinct olive brown (2.5Y 4/4) relict mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; common threadlike accumulations of lime; violent effervescence; moderately alkaline; abrupt smooth boundary.

2C3—55 to 60 inches; dark grayish brown (2.5Y 4/2) loamy very fine sand, grayish brown (2.5Y 5/2) dry; single grain; loose; nonsticky and nonplastic; about 10 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The depth to carbonates ranges from 10 to 32 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6 (6 to 8 dry), and chroma of 2 to 4. The C horizon has value of 4 to 6 (5 to 8 dry). The Bw, Bk, and C horizons are silt loam or silty clay loam. Some pedons do not have a 2C horizon.

Hamerly Series

The Hamerly series consists of very deep, somewhat poorly drained, moderately slowly permeable, highly calcareous soils on till plains. These soils formed in glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Hamerly loam, in an area of Hamerly-Tonka complex, 0 to 3 percent slopes; 2,205 feet south and 215 feet east of the northwest corner of sec. 15, T. 144 N., R. 65 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; about 3 percent gravel; common fine rounded soft masses of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk—9 to 28 inches; light olive brown (2.5Y 5/4) loam, light gray (2.5Y 7/2) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; common medium rounded soft masses of lime; about 3 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—28 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent red (2.5YR 4/8) and common medium prominent light gray (N 7/0) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic, about 3 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 15 inches. Some pedons are saline.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6 (6 to 8 dry), and chroma of 1 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (6 to 8 dry), and chroma of 2 to 4. The Bk and C horizons are loam or clay loam.

Hecla Series

The Hecla series consists of very deep, moderately well drained, rapidly permeable soils on outwash plains and lake plains. These soils formed in glaciofluvial and glaciolacustrine deposits. Slope ranges from 0 to 6 percent.

Typical pedon of Hecla loamy fine sand, in an area of Hecla-Towner loamy fine sands, 1 to 6 percent slopes; 675 feet north and 155 feet east of the southwest corner of sec. 35, T. 144 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak medium granular structure; soft and very friable; slightly sticky and slightly plastic; common very fine and fine roots; neutral; abrupt smooth boundary.

A—7 to 17 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; soft and very friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

AC—17 to 23 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; soft and very friable; nonsticky and nonplastic; few very fine roots; neutral; gradual wavy boundary.

C1—23 to 33 inches; dark grayish brown (10YR 4/2) loamy sand, grayish brown (10YR 5/2) dry; few fine faint dark brown (10YR 3/3) mottles; massive; soft and very friable; nonsticky and nonplastic; few very fine roots; few fine very dark grayish brown (10YR 3/2) concretions of iron and manganese; neutral; gradual wavy boundary.

C2—33 to 60 inches; dark grayish brown (2.5Y 4/2) loamy sand, light brownish gray (2.5Y 6/2) dry; common fine and medium distinct dark brown (10YR 4/3) and few fine prominent dark yellowish brown (10YR 3/4) mottles; massive; soft and very friable; nonsticky and nonplastic; few fine very dark grayish brown (10YR 3/2) concretions of iron and manganese; neutral.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to carbonates ranges from 20 to more than 60 inches.

The A horizon has value of 2 or 3 (3 or 4 dry) and chroma of 1 or 2. The AC horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. The AC and C horizons are loamy fine sand, loamy sand, or fine sand. The C horizon has value of 3 to 5 (4 to 7 dry) and chroma of 2 to 4.

Kloten Series

The Kloten series consists of shallow, well drained, moderately permeable soils in stream valleys. These soils formed in glacial till and material weathered from shale bedrock. Slope ranges from 9 to 50 percent.

Typical pedon of Kloten loam, in an area of Kloten-Buse loams, 9 to 50 percent slopes; 1,950 feet west and 30 feet north of the southeast corner of sec. 35, T. 142 N., R. 64 W.

A—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine and medium subangular blocky structure parting to moderate fine and medium granular; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 2 percent shale fragments; neutral; clear wavy boundary.

AC—6 to 10 inches; very dark grayish brown (2.5Y 3/2) loam, dark grayish brown (2.5Y 4/2) dry; massive; soft and very friable; slightly sticky and slightly plastic; few very fine roots; about 10 percent shale fragments; neutral; abrupt wavy boundary.

Cr1—10 to 20 inches; dark olive gray (5Y 3/2) fractured shale bedrock, olive gray (5Y 4/2) dry; fractures more than 4 inches apart; few very fine roots in fractures; common dark reddish brown (5YR 3/4) iron stains on bottoms of individual fragments; abrupt wavy boundary.

Cr2—20 inches; dark olive gray (5Y 3/2) unweathered shale bedrock, olive gray (5Y 4/2) dry; common dark reddish brown (5YR 3/4) iron stains on bottoms of individual fragments.

The depth to bedrock ranges from 10 to 20 inches. The A and AC horizons have hue of 10YR or 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. Some pedons have a thin C horizon.

La Prairie Series

The La Prairie series consists of very deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of La Prairie silt loam, in an area of La Prairie and Lamoure soils, channeled; 645 feet east and 100 feet south of the northwest corner of sec. 31, T. 138 N., R. 62 W.

A—0 to 14 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate fine granular; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; neutral; clear wavy boundary.

Bw1—14 to 30 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many very fine roots; slight effervescence; slightly alkaline; clear wavy boundary.

Bw2—30 to 45 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine roots; few fine irregularly shaped soft masses of lime in the lower part; slight effervescence; slightly alkaline; gradual wavy boundary.

Bk—45 to 60 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; common fine irregularly shaped soft masses of lime; strong effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 16 to more than 40 inches. The depth to carbonates ranges from 0 to 30 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 dry, and chroma of 1 to 3. The Bw and Bk horizons are loam or silt loam. Some pedons do not have a Bk horizon. Some pedons have a C horizon. This horizon has hue of 10YR to 5Y, value of 3 to 5 (4 to 7 dry), and chroma of 1 to 3.

Lamoure Series

The Lamoure series consists of very deep, poorly drained, moderately slowly permeable, calcareous soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Lamoure silty clay loam, in an area of La Prairie and Lamoure soils, channeled; 340 feet east and 250 feet south of the northwest corner of sec. 31, T. 138 N., R. 62 W.

A1—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; slightly alkaline; clear wavy boundary.

A2—9 to 24 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many very fine roots; slight effervescence; slightly alkaline; clear irregular boundary.

A3—24 to 35 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

Cg1—35 to 51 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 5/1) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; slight effervescence; slightly alkaline; clear wavy boundary.

Cg2—51 to 60 inches; dark olive gray (5Y 3/2) silty clay loam, light olive gray (5Y 6/2) dry; few fine prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; slight effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 24 to 42 inches. The A horizon has value of 3 to 5 dry. Some pedons have an Ab horizon below a depth of 30 inches that is 2 to 8 inches thick. The Cg horizon has hue of 2.5Y or 5Y and value of 3 to 5 (4 to 6 dry). It is silt loam or silty clay loam.

Larson Series

The Larson series consists of very deep, somewhat poorly drained, sodic soils on mantled till plains. These soils formed in glacial till. Permeability is slow in the upper part of the profile and moderate in the lower part. Slope ranges from 1 to 6 percent.

Typical pedon of Larson fine sandy loam, in an area of Swenoda-Larson fine sandy loams, 1 to 6 percent slopes; 725 feet west and 820 feet north of the southeast corner of sec. 3, T. 143 N., R. 64 W.

Ap—0 to 6 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine roots; neutral; abrupt smooth boundary.

E—6 to 8 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) fine sandy loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; weak coarse prismatic structure parting to moderate medium and thick platy; slightly hard and very

friable; slightly sticky and nonplastic; common very fine roots; neutral; abrupt smooth boundary.

Btn1—8 to 17 inches; dark brown (10YR 3/3) clay loam, brown (10YR 5/3) dry; strong coarse prismatic structure parting to moderate fine angular blocky; very hard and firm; sticky and plastic; common very fine roots; common distinct black (10YR 2/1) clay films on faces of peds; slightly alkaline; clear smooth boundary.

Btn2—17 to 21 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard and firm; slightly sticky and slightly plastic; common very fine roots; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; slightly alkaline; clear smooth boundary.

Bky—21 to 35 inches; light brownish gray (2.5Y 6/2) loam, white (2.5Y 8/2) dry; moderate coarse prismatic structure parting to weak medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; about 2 percent gravel; common medium irregularly shaped masses of gypsum; lime disseminated throughout; violent effervescence; moderately alkaline; clear smooth boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent dark brown (7.5YR 3/4) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; about 2 percent gravel; lime disseminated throughout; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 to 5 dry). The E horizon has hue of 10YR or 2.5Y, value of 2 to 5 (5 to 7 dry), and chroma of 1 to 3. It is fine sandy loam or loam. The Btn horizon has value of 2 to 4 (4 to 6 dry) and chroma of 1 to 3. The Bky horizon has hue of 2.5Y or 5Y and value of 4 to 6 (5 to 8 dry). It is loam or clay loam. The C horizon has hue of 10YR to 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4.

Maddock Series

The Maddock series consists of very deep, well drained, rapidly permeable soils on outwash plains. These soils formed in glaciofluvial deposits and eolian soil material. Slope ranges from 0 to 15 percent.

The Maddock series in this county have a mollic epipedon that is lighter in color than is definitive for the series. This difference, however, does not affect the use and management of the soils.

Typical pedon of Maddock loamy fine sand, 0 to 6 percent slopes, 2,200 feet north and 600 feet east of the southwest corner of sec. 21, T. 144 N., R. 66 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; soft and very friable; nonsticky and nonplastic; few fine roots; neutral; clear smooth boundary.

A—8 to 15 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; soft and very friable; nonsticky and nonplastic; few fine roots; neutral; gradual wavy boundary.

Bw—15 to 32 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; soft and very friable; nonsticky and nonplastic; few fine roots; neutral; gradual wavy boundary.

C—32 to 60 inches; brown (10YR 5/3) fine sand, very pale brown (10YR 7/3) dry; single grain; loose; nonsticky and nonplastic; lime disseminated throughout; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The depth to carbonates ranges from 10 to 35 inches.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. The Bw horizon has value of 2 to 5 (4 to 6 dry) and chroma of 2 to 4. It is fine sand, loamy fine sand, or loamy sand. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 2 to 4. It is fine sand or sand.

Marysland Series

The Marysland series consists of very deep, poorly drained, highly calcareous soils on outwash plains. These soils formed in glaciofluvial deposits and alluvium. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope is 0 to 1 percent.

Typical pedon of Marysland loam, in an area of Divide-Marysland loams, 0 to 3 percent slopes; 2,090 feet south and 450 feet east of the northwest corner of sec. 32, T. 137 N., R. 64 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; many fine roots; strong effervescence; slightly alkaline; abrupt wavy boundary.

Bkg1—8 to 15 inches; gray (5Y 6/1) clay loam, light gray (5Y 7/1) dry; weak fine and medium subangular blocky structure; slightly hard and

friable; slightly sticky and slightly plastic; common fine roots; tongues of black (10YR 2/1) loam; common fine rounded soft masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg2—15 to 21 inches; olive gray (5Y 4/2) loam, olive gray (5Y 5/2) dry; few fine prominent light olive brown (2.5Y 5/4) mottles; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; few fine concretions of manganese oxide; few fine rounded soft masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg3—21 to 27 inches; olive gray (5Y 5/2) loam, light olive gray (5Y 6/2) dry; few fine prominent light olive brown (2.5Y 5/4) and few fine faint pale olive (5Y 6/3) mottles; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; few fine concretions of manganese oxide; few fine rounded soft masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

Bkg4—27 to 32 inches; light brownish gray (2.5Y 6/2) loam, light gray (5Y 7/2) dry; few fine distinct light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; few fine concretions of manganese oxide; few fine rounded soft masses of lime; violent effervescence; moderately alkaline; abrupt smooth boundary.

2C—32 to 60 inches; light olive brown (2.5Y 5/4) coarse sand, light yellowish brown (2.5Y 6/4) dry; single grain; loose; nonsticky and nonplastic; about 10 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 30 inches. The depth to sand ranges from 20 to 40 inches.

The A horizon has hue of 10YR to 5Y and value of 2 or 3 (3 to 5 dry). The Bk horizon has hue of 10YR to 5Y and value of 3 to 6 (4 to 7 dry). It is loam, clay loam, or sandy clay loam. The 2C horizon has hue of 2.5Y or 5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 to 4.

Minnewaukan Series

The Minnewaukan series consists of very deep, poorly drained soils on lake plains. These soils formed in glaciolacustrine deposits. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 3 percent.

Typical pedon of Minnewaukan loamy sand, loamy substratum, 0 to 3 percent slopes, 2,080 feet south and 1,250 feet east of the northwest corner of sec. 28, T. 142 N., R. 67 W.

A—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; soft and very friable; nonsticky and nonplastic; many fine roots; about 10 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

C—8 to 13 inches; dark grayish brown (10YR 4/2) gravelly sand, grayish brown (10YR 5/2) dry; single grain; loose; nonsticky and nonplastic; few fine roots; about 25 percent gravel; slight effervescence; moderately alkaline; abrupt smooth boundary.

Cg1—13 to 41 inches; gray (5Y 5/1) sand, light gray (5Y 6/1) dry; few fine prominent light olive brown (2.5Y 5/4) mottles; single grain; loose; nonsticky and nonplastic; about 10 percent gravel; slight effervescence; moderately alkaline; clear wavy boundary.

2Cg2—41 to 60 inches; olive gray (5Y 5/2) clay loam, light gray (5Y 7/2) dry; few fine prominent light olive brown (2.5Y 5/4) mottles; massive; hard and firm; slightly sticky and slightly plastic; about 3 percent gravel; strong effervescence; moderately alkaline.

Depth to the 2C horizon ranges from 40 to 60 inches. The A horizon has hue of 10YR to 5Y, value of 2 to 4 (3 to 6 dry), and chroma of 1 or 2. Some pedons have an AC horizon. The C horizon and 2C horizons have hue of 10YR to 5Y, value of 3 to 5 (4 to 7 dry), and chroma of 1 to 4. The 2C horizon is clay loam or loam.

Miranda Series

The Miranda series consists of very deep, somewhat poorly drained, very slowly permeable, sodic, saline soils on till plains. These soils formed in glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Miranda loam, in an area of Cavour-Miranda loams, 0 to 3 percent slopes; 680 feet west and 530 feet north of the southeast corner of sec. 25, T. 143 N., R. 65 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; neutral; abrupt wavy boundary.

Btnz1—6 to 11 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; strong medium and coarse columnar structure; very hard and firm; sticky and plastic; few fine roots; many faint black (10YR 2/1) clay films on faces of peds; light gray (10YR 7/2) coatings on top of columns; few fine

nests of salts; neutral; clear wavy boundary.
Btnz2—11 to 14 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure; hard and firm; sticky and plastic; few fine roots; common faint black (10YR 2/1) clay films on faces of peds; common fine nests of salts; slight effervescence in the lower part; slightly alkaline; clear wavy boundary.
Bkz1—14 to 21 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many fine nests of salts; common fine irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.
Bkz2—21 to 34 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; common fine distinct light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine nests of salts; common fine irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.
C—34 to 60 inches; dark gray (5Y 4/1) loam, gray (5Y 5/1) dry; common fine prominent olive brown (2.5Y 4/4) and few fine prominent light olive brown (2.5Y 5/4) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few fine irregularly shaped soft masses of lime; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 8 to 25 inches. The depth to gypsum or other salts ranges from 6 to 16 inches.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. Some uncultivated pedons have an E horizon, which is 1 to 3 inches thick. The Btnz horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 6 dry), and chroma of 1 to 4. It is clay loam or loam. The Bk horizon has hue of 10YR to 5Y, value of 3 to 6 (3 to 7 dry), and chroma of 2 to 4. The C horizon has hue of 10YR to 5Y, value of 3 to 7 (4 to 8 dry), and chroma of 1 to 4.

Overly Series

The Overly series consists of very deep, moderately well drained, moderately slowly permeable soils on lake plains. These soils formed in glaciolacustrine deposits. Slope ranges from 0 to 6 percent.

Typical pedon of Overly silty clay loam, in an area of Overly-Bearden silty clay loams, 0 to 3 percent slopes; 2,620 feet south and 150 feet west of the northeast corner of sec. 20, T. 139 N., R. 67 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; neutral; abrupt smooth boundary.
A—8 to 14 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; neutral; clear wavy boundary.
Bw—14 to 23 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; neutral; clear wavy boundary.
Bk—23 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; lime disseminated throughout; violent effervescence; moderately alkaline; clear wavy boundary.
C—32 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; few fine faint grayish brown (2.5Y 5/2) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; lime disseminated throughout; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 30 inches. The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3. The Bk horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 1 to 4. The Bw, Bk, and C horizons are silty clay loam or silt loam.

Parnell Series

The Parnell series consists of very deep, very poorly drained, slowly permeable soils on till plains and moraines. These soils formed in alluvium and glacial till. Slope is 0 to 1 percent.

Typical pedon of Parnell silty clay loam, in an area of Hamerly-Parnell complex, 0 to 3 percent slopes; 1,225 feet east and 1,050 feet south of the northwest corner of sec. 23, T. 144 N., R. 67 W.

A1—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to moderate medium

granular; slightly hard and friable; slightly sticky and slightly plastic; many fine and medium roots; neutral; clear smooth boundary.

A2—8 to 16 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to weak fine platy; slightly hard and friable; slightly sticky and slightly plastic; many fine and medium roots; neutral; clear smooth boundary.

Bt1—16 to 28 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate coarse prismatic structure parting to strong medium angular blocky; hard and firm; sticky and plastic; common very fine and fine roots; common faint black (10YR 2/1) clay films on faces of peds; neutral; clear wavy boundary.

Bt2—28 to 36 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to strong medium angular blocky; hard and firm; sticky and plastic; common very fine roots; few distinct black (10YR 2/1) clay films on faces of peds; neutral; gradual wavy boundary.

Cg—36 to 60 inches; olive gray (5Y 5/2) loam, light olive gray (5Y 6/2) dry; common fine prominent strong brown (7.5YR 5/6) and few fine prominent dark red (2.5YR 3/6) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; few fine rounded iron concretions of manganese oxide; about 2 percent gravel; neutral.

The thickness of the mollic epipedon ranges from 24 to 45 inches. The depth to carbonates ranges from 40 to more than 60 inches.

The A horizon has hue of 10YR to 5Y and value of 3 to 5 dry. The Bt horizon has hue of 10YR to 5Y and value of 2 to 4 (3 to 6 dry). It is silty clay loam, silty clay, or clay. The C horizon has hue of 2.5Y or 5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 or 2. It ranges from loam to clay.

Renshaw Series

The Renshaw series consists of very deep, somewhat excessively drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 6 percent.

Typical pedon of Renshaw loam, in an area of Fordville-Renshaw loams, 0 to 3 percent slopes; 2,070 feet north and 935 feet west of the southeast corner of sec. 30, T. 143 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard and friable; slightly sticky and slightly plastic; many fine and medium roots; about 5 percent gravel; neutral; abrupt smooth boundary.

Bw—7 to 15 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 5 percent gravel; neutral; clear wavy boundary.

2C—15 to 60 inches; light olive brown (2.5Y 5/4) gravelly sand, pale yellow (2.5Y 7/4) dry; single grain; loose; nonsticky and nonplastic; coatings of carbonates on underside of pebbles in the upper part; about 25 percent gravel; slight effervescence; slightly alkaline.

The depth to sand and gravel ranges from 14 to 20 inches. The thickness of the mollic epipedon ranges from 10 to 16 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has value of 3 or 4 (3 to 5 dry) and chroma of 1 to 4. It is loam, sandy clay loam, or gravelly loam.

Seelyeville Series

The Seelyeville series consists of very deep, very poorly drained, moderately permeable soils on till plains and outwash plains and in stream valleys. These soils formed in organic deposits. Slope ranges from 0 to 9 percent.

Typical pedon of Seelyeville mucky peat, 0 to 9 percent slopes, 1,175 feet east and 2,560 feet south of the northwest corner of sec. 36, T. 138 N., R. 63 W.

Oa1—0 to 2 inches; mucky peat, black (10YR 2/1) broken face and rubbed, dark grayish brown (10YR 4/2) dry; about 40 percent unrubbed, about 15 percent rubbed; moderate fine granular structure; soft and friable; slightly sticky and slightly plastic; many fine and few medium roots throughout; few fine snail shells; primarily herbaceous fibers; about 15 percent mineral material; strong effervescence; slightly alkaline; clear wavy boundary.

Oa2—2 to 16 inches; mucky peat, very dark grayish brown (10YR 3/2) broken face and rubbed, grayish brown (10YR 5/2) dry; about 25 percent unrubbed, about 10 percent rubbed; massive; soft and friable; nonsticky and nonplastic; many fine and few medium roots throughout; few fine snail shells; primarily herbaceous fibers; about 15 percent

mineral material; violent effervescence; slightly alkaline; gradual wavy boundary.

Oa3—16 to 37 inches; muck, very dark gray (10YR 3/1) broken face and rubbed, gray (10YR 6/1) dry; about 5 percent unrubbed and rubbed; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots throughout; few fine snail shells; about 25 percent mineral material; violent effervescence; slightly alkaline; clear wavy boundary.

Oa4—37 to 60 inches; muck, very dark grayish brown (10YR 3/2) broken face and rubbed, grayish brown (10YR 5/2) dry; about 5 percent unrubbed and rubbed; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots throughout; few fine snail shells; about 35 percent mineral material; violent effervescence; slightly alkaline.

The organic deposits are more than 51 inches thick. The subsurface and bottom tiers have value of 2 or 3 and chroma of 2. The subsurface tier is dominantly sapric material. The content of fiber in this tier is less than 16 percent of the organic volume after rubbing. The bottom tier is dominantly sapric material, but some pedons have thin layers of hemic material.

Sinai Series

The Sinai series consists of very deep, moderately well drained, slowly permeable soils on lake plains. These soils formed in glaciolacustrine deposits. Slope ranges from 0 to 6 percent.

Typical pedon of Sinai silty clay loam, 0 to 6 percent slopes, 2,575 feet north and 1,185 feet east of the southwest corner of sec. 11, T. 143 N., R. 68 W.

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; very hard and friable; sticky and plastic; common very fine and fine roots; neutral; abrupt smooth boundary.

A—6 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine granular; very hard and firm; sticky and plastic; common very fine and fine roots; neutral; clear wavy boundary.

Bw1—8 to 14 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate fine angular blocky; very hard and firm; sticky and plastic; few very fine roots; common cracks as much as 2.5 inches wide filled with very dark gray (10YR 3/1) A horizon material; neutral; clear wavy boundary.

Bw2—14 to 21 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate very fine and fine angular blocky; very hard and firm; sticky and plastic; few very fine roots; few cracks as much as 1 inch wide filled with very dark gray (10YR 3/1) A horizon material; neutral; clear wavy boundary.

Bk—21 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to moderate fine angular blocky; very hard and firm; sticky and plastic; few cracks less than 0.5 inch wide to a depth of 25 inches filled with very dark gray (10YR 3/1) A horizon material; lime disseminated throughout and in few fine irregularly shaped soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

C—29 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; few fine prominent dark reddish brown (5YR 3/4) and few fine faint light brownish gray (2.5Y 6/2) mottles; massive; very hard and firm; sticky and plastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 25 inches. The depth to carbonates ranges from 17 to 32 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 6 dry), and chroma of 1 to 3. It is silty clay or clay. The Bk and C horizons have hue of 10YR to 5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 to 6. They are silty clay loam or silty clay.

Sioux Series

The Sioux series consists of very deep, excessively drained, very rapidly permeable soils on outwash plains, terraces, and eskers. These soils formed in glaciofluvial deposits. Slope ranges from 0 to 35 percent.

Typical pedon of Sioux sandy loam, in an area of Arvilla-Sioux sandy loams, 0 to 3 percent slopes; 2,600 feet east and 45 feet south of the northwest corner of sec. 7. T. 142 N., R. 69 W.

A—0 to 7 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; soft and very friable; slightly sticky and slightly plastic; many very fine and fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

AC—7 to 10 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2)

dry; weak fine subangular blocky structure parting to weak fine granular; soft and very friable; slightly sticky and slightly plastic; common very fine and fine roots; about 6 percent gravel; neutral; abrupt wavy boundary.

C—10 to 60 inches; dark grayish brown (2.5Y 4/2) very gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; about 40 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 12 inches. The depth to sand and gravel ranges from 6 to 14 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). It is loam or sandy loam. The AC horizon has value of 3 or 4 (4 to 6 dry) and chroma of 2 or 3. It is loam, gravelly loam, gravelly sandy loam, loamy sand, or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 or 3. The content of gravel in individual layers of the C horizon ranges from 10 to 50 percent but averages more than 35 percent, by volume, throughout the horizon.

Southam Series

The Southam series consists of very deep, very poorly drained, slowly permeable, calcareous soils on till plains and lake plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Southam silty clay loam, 1,050 feet south and 725 feet west of the northeast corner of sec. 20, T. 142 N., R. 66 W.

Oe—2 inches to 0; black (5Y 2/1) peat, very dark grayish brown (2.5Y 3/2) dry; neutral; clear wavy boundary.

Ag1—0 to 6 inches; black (5Y 2/1) silty clay loam, dark gray (5Y 4/1) dry; massive; hard and firm; sticky and plastic; few coarse and many medium and fine roots; slight effervescence; slightly alkaline; gradual wavy boundary.

Ag2—6 to 18 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; massive; hard and firm; sticky and plastic; few fine roots; few fine snail shells; strong effervescence; moderately alkaline; gradual wavy boundary.

Ag3—18 to 27 inches; black (5Y 2/1) clay loam, dark gray (5Y 4/1) dry; massive; hard and firm; sticky and plastic; few fine roots; few fine snail shells; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg1—27 to 41 inches; dark greenish gray (5GY 4/1) silty clay, gray (5Y 5/1) dry; massive; hard and firm; sticky and plastic; common fine snail shells; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg2—41 to 60 inches; dark gray (5Y 4/1) silty clay, light gray (5Y 6/1) dry; massive; hard and firm; sticky and plastic; few fine snail shells; violent effervescence; moderately alkaline.

The depth to carbonates ranges from 0 to 10 inches. The A horizon has hue of 10YR to 5Y, or it is neutral in hue. It has value of 2 or 3 (3 to 5 dry) and chroma of 0 to 2. The C horizon has hue of 2.5Y, 5Y, 5GY, or it is neutral in hue. It has value of 3 to 7 (4 to 8 dry) and chroma of 0 or 2. It is silty clay, silty clay loam, clay loam, or clay.

Svea Series

The Svea series consists of very deep, well drained and moderately well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 0 to 25 percent.

Typical pedon of Svea loam, in an area of Svea-Barnes loams, 0 to 3 percent slopes; 1,030 feet south and 1,380 feet east of the northwest corner of sec. 5, T. 144 N., R. 64 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard and friable; slightly sticky and slightly plastic; many fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bw1—8 to 13 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bw2—13 to 22 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bk—22 to 33 inches; olive brown (2.5Y 4/4) loam, light gray (2.5Y 7/2) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; lime disseminated throughout; about 5 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—33 to 60 inches; olive brown (2.5Y 4/4) loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; lime

disseminated throughout; about 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to more than 30 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The A horizon has value of 2 or 3 (3 to 5 dry). The Bw, Bk, and C horizons are loam or clay loam. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 4. The Bk horizon has hue of 2.5Y or 10YR, value of 4 to 6 (5 to 8 dry), and chroma of 1 to 4. The C horizon has value of 4 or 5 (5 or 6 dry) and chroma of 2 to 4.

Swenoda Series

The Swenoda series consists of very deep, well drained and moderately well drained soils on mantled till plains. These soils formed in eolian soil material and glacial till. Permeability is moderately rapid in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 9 percent.

Typical pedon of Swenoda fine sandy loam, in an area of Swenoda-Buse complex, 3 to 6 percent slopes; 285 feet south and 415 feet east of the northwest corner of sec. 14, T. 143 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium granular structure; soft and very friable; slightly sticky and slightly plastic; common very fine roots; neutral; abrupt smooth boundary.

A—7 to 11 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak medium granular; soft and very friable; slightly sticky and slightly plastic; common very fine roots; neutral; clear wavy boundary.

Bw1—11 to 15 inches; very dark brown (10YR 2/2) fine sandy loam, dark brown (10YR 4/3) dry; weak medium prismatic structure parting to weak coarse subangular blocky; soft and friable; slightly sticky and slightly plastic; common very fine roots; neutral; clear wavy boundary.

Bw2—15 to 19 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to weak coarse subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

Bw3—19 to 29 inches; dark brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak medium prismatic structure parting to weak coarse subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

2Bk—29 to 43 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; weak medium and coarse subangular blocky structure; hard and firm; sticky and plastic; many coarse irregularly shaped soft masses of lime; about 5 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

2C—43 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent red (2.5YR 4/6) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; common medium irregularly shaped soft masses of lime; about 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 24 inches. Depth to the 2Bk horizon ranges from 20 to 40 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 6 dry, and chroma of 1 to 4. It is fine sandy loam or sandy loam. The 2Bk and 2C horizons are loam, silt loam, clay loam, or silty clay loam. The 2Bk horizon has hue of 2.5Y or 5Y, value of 4 to 6 (6 to 8 dry), and chroma of 2 to 6. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (6 to 8 dry), and chroma of 2 to 6.

Tonka Series

The Tonka series consists of very deep, poorly drained, slowly permeable soils on till plains. These soils formed in alluvium and glacial till. Slope is 0 to 1 percent.

Typical pedon of Tonka silt loam, in an area of Hamerly-Tonka complex, 0 to 3 percent slopes; 350 feet south and 1,550 feet east of the northwest corner of sec. 14, T. 140 N., R. 62 W.

A—0 to 11 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine and few medium and coarse roots; neutral; clear wavy boundary.

E—11 to 22 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 6/1) dry; many fine prominent dark brown (7.5YR 4/4) mottles; moderate thin and medium platy structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; neutral; abrupt wavy boundary.

Bt1—22 to 34 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; few fine prominent dark brown

(7.5YR 3/4) mottles; strong coarse prismatic structure parting to strong very fine and fine angular blocky; very hard and firm; very sticky and very plastic; common very fine and fine roots between peds; many faint black (10YR 2/1) clay films on faces of peds; neutral; gradual wavy boundary.

Bt2—34 to 41 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; many fine distinct dark grayish brown (10YR 4/2) and few fine prominent dark brown (7.5YR 4/4) mottles; strong coarse prismatic structure parting to strong very fine and fine angular blocky; very hard and firm; very sticky and very plastic; common very fine and fine roots between peds; common faint black (10YR 2/1) clay films on faces of peds; neutral; gradual wavy boundary.

BC—41 to 52 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; many fine distinct dark brown (10YR 4/3) and many fine prominent dark brown (7.5YR 4/4) mottles; strong fine angular blocky structure; hard and firm; sticky and plastic; few very fine roots; neutral; clear wavy boundary.

C—52 to 60 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; common fine prominent dark brown (7.5YR 4/4) and many medium distinct olive yellow (2.5Y 6/6) mottles; massive; hard and friable; slightly sticky and slightly plastic; slight effervescence; slightly alkaline.

The depth to carbonates ranges from 20 to more than 60 inches. The A horizon has hue of 10YR, or it is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. The E horizon has hue of 10YR or 2.5Y, value of 3 to 5 (5 to 7 dry), and chroma of 1 or 2. The Bt horizon has hue of 10YR to 5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. It is silty clay, silty clay loam, or clay loam. The C horizon is loam, silt loam, clay loam, or silty clay loam.

Towner Series

The Towner series consists of very deep, moderately well drained soils on mantled till plains. These soils formed in eolian soil material and glacial till. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 6 percent.

Typical pedon of Towner loamy fine sand, 0 to 3 percent slopes, 855 feet east and 2,295 feet south of the northwest corner of sec. 20, T. 144 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular structure; soft and very friable; nonsticky and nonplastic; common very fine and fine roots; neutral; abrupt smooth boundary.

A—7 to 20 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak medium and coarse prismatic structure parting to weak coarse subangular blocky; soft and very friable; nonsticky and nonplastic; few very fine roots; neutral; clear wavy boundary.

Bw—20 to 26 inches; dark brown (10YR 4/3) loamy sand, brown (10YR 5/3) dry; few fine faint dark yellowish brown (10YR 3/4) mottles; weak fine and medium prismatic structure; loose; nonsticky and nonplastic; neutral; gradual wavy boundary.

2Bk—26 to 41 inches; olive brown (2.5Y 4/4) loam, pale yellow (2.5Y 7/4) dry; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few fine concretions of iron and manganese oxide; common medium irregularly shaped soft masses of lime; about 5 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

2C—41 to 60 inches; dark grayish brown (2.5Y 4/2) loam, light gray (2.5Y 7/2) dry; common medium faint grayish brown (2.5Y 5/2) and many medium distinct olive brown (2.5Y 4/4) mottles; massive; hard and firm; sticky and plastic; about 5 percent gravel; slight effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 16 to 30 inches. Depth to the 2Bk horizon ranges from 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y and value of 2 to 4 (3 to 6 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 1 to 4. The Bw horizon is loamy fine sand, loamy sand, or fine sand. The 2Bk and 2C horizons are loam or clay loam. The 2C horizon has hue of 10YR to 5Y, value of 4 to 6 (6 to 8 dry), and chroma of 2 to 4.

Ulen Series

The Ulen series consists of very deep, somewhat poorly drained, rapidly permeable, highly calcareous soils on lake plains and outwash plains. These soils formed in glaciolacustrine and glaciofluvial deposits. Slope ranges from 0 to 3 percent.

Typical pedon of Ulen fine sandy loam, in an area of Hecla-Ulen complex, 0 to 3 percent slopes; 2,000 feet north and 1,550 feet west of the southeast corner of sec. 4, T. 143 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; soft and very friable; nonsticky and nonplastic; many

very fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk1—7 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak coarse prismatic structure parting to weak medium subangular blocky; soft and very friable; nonsticky and nonplastic; common very fine roots; common irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—12 to 22 inches; grayish brown (2.5Y 5/2) fine sandy loam, light gray (2.5Y 7/2) dry; weak coarse prismatic structure parting to weak medium subangular blocky; soft and very friable; nonsticky and nonplastic; few very fine roots; common soft irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

C—22 to 60 inches; light olive gray (5Y 6/2) loamy fine sand, white (5Y 8/2) dry; single grain; loose; nonsticky and nonplastic; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. The A horizon has value of 2 or 3 (3 or 4 dry) and chroma of 1 or 2. The Bk horizon has value of 5 to 7 dry and chroma of 2 or 3. It is fine sandy loam, sandy loam, or loamy sand. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 8 dry), and chroma of 2 to 6. It is loamy fine sand, fine sand, or sand.

Vallers Series

The Vallers series consists of very deep, poorly drained, moderately slowly permeable, highly calcareous, saline soils on till plains and in channels. These soils formed in glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Vallers silty clay loam, in an area of Hamerly, Vallers, and Colvin soils, saline, 0 to 3 percent slopes; 25 feet east and 30 feet south of the northwest corner of sec. 15, T. 137 N., R. 64 W.

Apz—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard and firm; slightly sticky and slightly plastic; few fine roots; common nests of salts; violent effervescence; moderately alkaline; abrupt smooth boundary.

Bkzg—7 to 13 inches; gray (5Y 6/1) silty clay loam, light gray (5Y 7/1) dry; weak medium prismatic structure; slightly hard and firm; slightly sticky and slightly plastic; tongues of very dark grayish brown (10YR 3/2) A horizon material; common nests of salts; common fine rounded soft masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

Bkyg1—13 to 22 inches; olive gray (5Y 5/2) clay loam, light olive gray (5Y 6/2) dry; few coarse prominent yellowish brown (10YR 5/8) mottles; weak medium prismatic structure; slightly hard and friable; slightly sticky and slightly plastic; common nests of gypsum crystals; common fine rounded soft masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

Bkyg2—22 to 30 inches; olive gray (5Y 5/2) clay loam, light olive gray (5Y 6/2) dry; few fine prominent yellowish brown (10YR 5/8) mottles; weak medium prismatic structure; slightly hard and friable; slightly sticky and slightly plastic; many nests of gypsum; common fine rounded soft masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

Cg—30 to 60 inches; gray (5Y 5/1) clay loam, light gray (5Y 6/1) dry; common medium prominent yellowish brown (10YR 5/8) and few medium prominent dark brown (7.5YR 3/4) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few fine nests of gypsum crystals; few fine rounded soft masses of lime; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. The A horizon has value of 2 or 3 (3 or 4 dry). The Bk horizon has hue of 10YR to 5Y and value of 3 to 6 (4 to 7 dry). It is loam, silty clay loam, or clay loam. The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 7 (5 to 8 dry), and chroma of 1 to 3. It is loam or clay loam.

Wyard Series

The Wyard series consists of very deep, somewhat poorly drained, moderately permeable soils on till plains. These soils formed in alluvium and glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Wyard loam, in an area of Hamerly-Wyard loams, 0 to 3 percent slopes; 1,720 feet south and 280 feet east of the northwest corner of sec. 7, T. 144 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; slightly hard and friable; slightly sticky and slightly plastic; many fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium and coarse prismatic structure parting to weak coarse

subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common fine and medium roots; about 2 percent gravel; neutral; gradual wavy boundary.

A2—14 to 20 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; few fine prominent olive brown (2.5Y 4/4) mottles; moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bw—20 to 25 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; common fine distinct olive brown (2.5Y 4/4) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 2 percent gravel; neutral; abrupt wavy boundary.

Bk—25 to 36 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; few fine distinct light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; lime disseminated throughout; about 2 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light yellowish brown (2.5Y 6/4) loam, light gray (2.5Y 7/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; lime disseminated throughout; about 2 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 24 inches. The content of gravel ranges from 2 to 5 percent throughout the profile.

The A horizon has value of 2 or 3 (3 to 5 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (4 to 6 dry), and chroma of 1 to 4. The Bk horizon has value of 4 to 6 (5 to 8 dry) and chroma of 2 to 4. The C horizon has value of 4 to 6 (5 to 7 dry). The Bk and C horizons are loam or clay loam.

Wyndmere Series

The Wyndmere series consists of very deep, somewhat poorly drained, highly calcareous soils on outwash plains and lake plains. These soils formed in glaciofluvial and glaciolacustrine deposits. Permeability is moderately rapid in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 3 percent.

Typical pedon of Wyndmere fine sandy loam, 0 to 3 percent slopes, 850 feet north and 230 feet east of the southwest corner of sec. 3, T. 144 N., R. 66 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; soft and friable; slightly sticky and slightly plastic; few fine roots; slight effervescence; moderately alkaline; abrupt smooth boundary.

ABk—9 to 15 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; soft and friable; slightly sticky and slightly plastic; few fine roots; lime disseminated throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bk—15 to 32 inches; dark grayish brown (2.5Y 4/2) and light olive brown (2.5Y 5/4) fine sandy loam, grayish brown (2.5Y 5/2) dry; weak fine and medium subangular blocky structure; soft and friable; slightly sticky and slightly plastic; few fine roots; lime disseminated throughout; violent effervescence; moderately alkaline; clear wavy boundary.

C1—32 to 44 inches; light olive brown (2.5Y 5/4) loamy fine sand, pale yellow (2.5Y 7/4) dry; few fine distinct grayish brown (2.5Y 5/2) mottles; single grain; loose; nonsticky and nonplastic; few fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

C2—44 to 51 inches; light olive brown (2.5Y 5/4) loamy fine sand, light yellowish brown (2.5Y 6/4) dry; few fine distinct grayish brown (2.5Y 5/2) mottles; single grain; loose; nonsticky and nonplastic; violent effervescence; moderately alkaline; abrupt smooth boundary.

2C3—51 to 60 inches; grayish brown (2.5Y 5/2) stratified loam and silt loam, light brownish gray (2.5Y 6/2) dry; common fine and medium prominent strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) mottles; massive; slightly hard and friable; slightly sticky and slightly plastic; few fine coatings of manganese; few fine rounded soft masses of lime; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The A and ABk horizons have value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. The Bk horizon has hue of 2.5Y or 10YR, value of 3 to 6 (4 to 8 dry), and chroma of 1 to 4. The C horizon has hue of 10YR to 5Y and value of 4 to 7 (5 to 8 dry).

Formation of the Soils

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. Soil characteristics are determined by the physical and mineralogical composition of the parent material; the climate under which the soil formed and has existed since formation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Some time is always required for the differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

Parent Material

The soils in Stutsman County formed in glacial drift. As the glacier advanced, it picked up rocks and soil, ground and mixed them, and deposited the material as the ice melted from the receding glacier. Some soils, such as Barnes and Svea soils, formed in unsorted material, or glacial till. Other soils, such as Bearden and Fargo soils, formed in glaciolacustrine deposits, or glacial material deposited by water in glacial lakes. Still other soils, such as Divide and Sioux soils, formed in glaciofluvial deposits, or material deposited by glacial meltwater.

Climate

Climate has direct and indirect effects on the formation of soils. Precipitation, temperature, and wind directly affect the weathering and reworking of parent material. Climate indirectly affects soil formation through its effects on the amount and kind of vegetation and animal life on or in the soil.

Stutsman County has a continental, semiarid climate that is characterized by long, cold winters and short, warm summers. The precipitation falls mainly during the growing season but is at times erratic. This type of climate favors the mechanical processes of weathering, such as freezing and thawing, which decrease particle size but result in little change in chemical composition.

In addition to weathering the parent material, precipitation and temperature affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil. Cool temperatures affect the content of organic matter by slowing the decay of plant material and animal remains.

Plant and Animal Life

The soils in Stutsman County formed mainly under grasses. Grasses provide a plentiful supply of organic matter, which improves the chemical and physical properties of the soil. The fibrous roots of these grasses penetrate the soil to a depth of several feet, making it more porous and more granular. As a result, less water runs off the surface and more moisture is available for increased microbiological activity. The decay of the plants improves the available water capacity, tilth, and fertility of the soil. The decayed organic matter, accumulating over long periods, gives the surface layer its dark color.

Micro-organisms have important effects on soil formation because they feed on undecomposed organic matter and convert it into humus from which plants can obtain nutrients for increased growth. Bacteria and different kinds of fungi attack leaves and other forms of organic matter. Insects, earthworms, and small burrowing animals help to mix the humus with the soil.

Human activities can greatly affect soil formation. Management measures can alter drainage. They also can help to control erosion and thus maintain fertility. Poor management can increase the susceptibility of the soil to erosion, which can result in an unproductive soil.

Relief

The slope of the soils in the county ranges from level to very steep. The degree of slope and the shape of the surface influence each soil through their

effects on runoff and internal drainage.

In areas where slopes are steep, much of the precipitation is lost as runoff. Therefore, vegetation is sparse and the degree of leaching and profile development is restricted. Buse soils are an example of soils in these areas. Svea and other soils in the lower areas receive additional moisture because of their position on the landscape. Therefore, they are leached to a greater degree than other soils and have a more deeply developed profile and the growth of plants is more luxuriant.

Soils in depressions vary widely in profile development, depending on the degree of wetness. Tonka soils, which are in shallow depressions, exhibit an advanced degree of horizonation because of the alternating wet and dry cycles that occur in the depressions. Because of the increased moisture in the depressions, Tonka soils exhibit properties much like soils in areas of much higher precipitation. Southam soils, which are in the deeper depressions, are nearly continuously wet and have a thick surface layer and carbonates throughout. The profile development in these soils is mostly the result of sedimentary processes rather than soil-forming processes *(4)*.

Time

Soil formation is a very slow process. Much time is required for the processes of soil formation to act on the parent material and to form distinct horizons within the soil profile. Approximately 10,000 to 12,000 years have passed since the glacier receded from Stutsman County. In geologic terms, the soils in the county are young.

More time has been available for the formation of Barnes soils on glacial till plains than for the formation of La Prairie soils on flood plains. The processes of soil formation have been continually acting on the parent material of the Barnes soils. As a result, these soils have well defined horizons. La Prairie soils continually receive new parent material at the surface as a result of flooding. As a result, they have less distinct horizons.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Diversion (or diversion terrace). A ridge of earth,

generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then

deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Lake plain. A nearly level area marking the floor of an extinct lake filled with well sorted, stratified sediments.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Organic matter. Plant and animal residue in the soil

in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root shearing. The cutting, tearing, and disruption of plant roots by the hooves of animals in areas that are grazed when the soil is wet and soft.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-sodic soil. A soil containing enough soluble salts and exchangeable sodium to interfere with the growth of plants.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey area the slope classes are:

Level	0 to 1 percent
Level and nearly level	0 to 3 percent
Nearly level	1 to 3 percent

Gently sloping or undulating ..... 3 to 6 percent
Moderately sloping or gently rolling ..... 6 to 9 percent
Strongly sloping or rolling ..... 9 to 15 percent
Moderately steep or hilly ..... 15 to 25 percent
Steep ..... 25 to 35 percent
Very steep ..... more than 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to Ca^{++} Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight ..... less than 13:1
Moderate 13-30:1
Strong ..... more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil depth. The distance from the top of the soil to the underlying bedrock. The distance, in inches, is expressed as:

Very shallow ..... less than 10
Shallow ..... 10 to 20
Moderately deep ..... 20 to 40
Deep ..... 40 to 60
Very deep ..... more than 60

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand ..... 2.0 to 1.0
Coarse sand ..... 1.0 to 0.5
Medium sand ..... 0.5 to 0.25
Fine sand ..... 0.25 to 0.10
Very fine sand ..... 0.10 to 0.05
Silt ..... 0.05 to 0.002
Clay ..... less than 0.002

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. An E horizon below an A horizon. If the E horizon is exposed, it is called the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. An A horizon that is 4 to 9 inches (10 to 24 centimeters) thick.

Surface soil. An A horizon that is 10 inches (25 centimeters) or more thick.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand,

loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-87 at Jamestown, North Dakota)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	16.1	-3.1	6.5	45	-31	0	0.60	0.18	0.90	2	7.0
February	23.7	4.2	14.0	50	-27	11	.56	.13	.87	2	5.7
March	35.2	15.9	25.6	66	-17	50	.80	.20	1.22	3	6.8
April	53.8	30.8	42.3	86	8	177	1.52	.34	2.44	4	3.2
May	67.9	42.0	55.0	92	23	473	2.24	.91	3.17	6	.4
June	76.3	52.1	64.2	96	36	726	3.44	1.54	4.76	7	.0
July	83.5	57.5	70.5	101	43	946	2.92	1.28	4.18	6	.0
August	82.2	55.0	68.6	102	38	887	2.08	.86	3.01	5	.0
September	69.8	44.1	57.0	97	25	510	1.60	.41	2.53	4	.0
October	57.4	33.7	45.6	85	14	211	1.03	.24	1.56	3	.8
November	37.2	18.2	27.7	70	-12	31	.57	.09	.82	2	4.1
December	22.7	4.3	13.5	51	-26	13	.50	.14	.77	2	5.2
Yearly:											
Average	52.2	29.8	40.9	---	---	---	---	---	---	---	---
Extreme	---	---	---	104	-32	---	---	---	---	---	---
Total	---	---	---	---	---	4,035	17.86	14.08	21.08	46	33.2

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-87 at Jamestown, North Dakota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 13	May 18	May 26
2 years in 10 later than--	May 6	May 11	May 20
5 years in 10 later than--	Apr. 22	Apr. 27	May 9
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 8	Sept. 20	Sept. 5
2 years in 10 earlier than--	Oct. 12	Sept. 25	Sept. 10
5 years in 10 earlier than--	Oct. 19	Oct. 4	Sept. 22

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-87 at Jamestown, North Dakota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	157	138	108
8 years in 10	165	146	117
5 years in 10	179	159	135
2 years in 10	194	173	153
1 year in 10	202	180	163

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Southam silty clay loam	41,150	2.8
2	Parnell silty clay loam	36,190	2.5
3	Tonka silt loam	7,330	0.5
4	Hamerly-Parnell complex, 0 to 3 percent slopes	25,720	1.7
5	Hamerly-Tonka complex, 0 to 3 percent slopes	41,530	2.8
13	Hamerly, Vallers, and Colvin soils, saline, 0 to 3 percent slopes	40,500	2.8
15	Hamerly loam, 0 to 3 percent slopes	9,600	0.7
16	Hamerly-Wyard loams, 0 to 3 percent slopes	12,230	0.8
18	Hamerly-Svea loams, 0 to 3 percent slopes	56,930	3.9
23B	Barnes-Svea loams, 3 to 6 percent slopes	179,680	12.2
23C	Barnes-Buse loams, 6 to 9 percent slopes	180,440	12.3
23D	Barnes-Buse loams, 9 to 15 percent slopes	104,970	7.1
23F	Buse-Svea loams, 15 to 50 percent slopes	32,150	2.2
24	Svea-Barnes loams, 0 to 3 percent slopes	116,450	7.9
24B	Svea-Buse loams, 3 to 6 percent slopes	101,070	6.9
24E	Barnes-Svea-Buse loams, 9 to 25 percent slopes	83,950	5.7
25E	Barnes-Buse-Parnell complex, 0 to 35 percent slopes	15,400	1.0
30C	Svea-Sioux loams, 3 to 9 percent slopes	20,400	1.4
30E	Sioux-Barnes loams, 9 to 30 percent slopes	16,920	1.2
39F	Kloten-Buse loams, 9 to 50 percent slopes	8,880	0.6
40	Divide-Marysland loams, 0 to 3 percent slopes	11,670	0.8
41	Fordville-Renshaw loams, 0 to 3 percent slopes	23,170	1.6
41B	Fordville-Renshaw loams, 3 to 6 percent slopes	7,930	0.5
44	Arvilla-Sioux sandy loams, 0 to 3 percent slopes	14,550	1.0
44C	Sioux-Arvilla sandy loams, 1 to 9 percent slopes	39,450	2.7
44E	Sioux-Arvilla sandy loams, 9 to 35 percent slopes	21,400	1.5
47B	Renshaw-Sioux loams, 0 to 6 percent slopes	5,560	0.4
48B	Maddock loamy fine sand, 0 to 6 percent slopes	1,150	0.1
48D	Maddock loamy fine sand, 6 to 15 percent slopes	1,240	0.1
49	Wyndmere fine sandy loam, 0 to 3 percent slopes	1,990	0.1
50	Fossum fine sandy loam	670	*
51	Arveson loam, saline	1,280	0.1
52	Hecla-Ulen complex, 0 to 3 percent slopes	4,320	0.3
54B	Hecla-Towner loamy fine sands, 1 to 6 percent slopes	3,190	0.2
55	Towner loamy fine sand, 0 to 3 percent slopes	2,360	0.2
56	Swenoda fine sandy loam, 0 to 3 percent slopes	14,030	1.0
56B	Swenoda-Buse complex, 3 to 6 percent slopes	14,890	1.0
56C	Swenoda-Buse complex, 6 to 9 percent slopes	4,460	0.3
57B	Embden fine sandy loam, 0 to 6 percent slopes	3,360	0.2
58B	Clontarf fine sandy loam, 0 to 6 percent slopes	2,830	0.2
60	Hamerly-Cresbard loams, 0 to 3 percent slopes	14,990	1.0
61B	Swenoda-Larson fine sandy loams, 1 to 6 percent slopes	2,190	0.1
62	Svea-Cresbard loams, 0 to 3 percent slopes	20,520	1.4
62B	Barnes-Cresbard loams, 3 to 6 percent slopes	19,730	1.3
63	Cresbard-Cavour loams, 0 to 3 percent slopes	6,280	0.4
64	Cavour-Miranda loams, 0 to 3 percent slopes	2,500	0.2
66	Exline silt loam	3,230	0.2
70	Colvin silty clay loam, wet	3,190	0.2
72	Minnewaukan loamy sand, loamy substratum, 0 to 3 percent slopes	1,960	0.1
73	Overly-Bearden silty clay loams, 0 to 3 percent slopes	4,000	0.3
73B	Great Bend-Overly silty clay loams, 3 to 6 percent slopes	2,910	0.2
74	Aberdeen silty clay loam	1,610	0.1
76	Fargo-Colvin silty clay loams	1,960	0.1
77	Colvin silty clay loam	4,060	0.3
79B	Sinai silty clay loam, 0 to 6 percent slopes	16,010	1.1
88C	Seelyeville mucky peat, 0 to 9 percent slopes	540	*
90	Lamoure silty clay loam	7,620	0.5
92	La Prairie and Lamoure soils, channeled	9,870	0.7
93	La Prairie silt loam, 0 to 3 percent slopes	3,730	0.3

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
94	Darnen loam, 0 to 3 percent slopes	1,170	0.1
94B	Darnen loam, 3 to 6 percent slopes	2,290	0.2
100	Pits, sand and gravel	1,970	0.1
	Water	27,080	1.8
	Total	1,470,400	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of management. For poorly and very poorly drained soils, however, the yields are those expected in undrained areas. Absence of an entry indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Sunflowers	Bromegrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
1. Southam						
2---------- Parnell	8	17	13	4	400	2.8
3---------- Tonka	16	34	26	8	800	2.8
4---------- Hamerly-Parnell	18	38	29	9	900	2.5
5---------- Hamerly-Tonka	26	55	42	13	1,300	2.5
13---------- Hamerly, Vallers, and Colvin	8	17	13	4	400	2.1
15---------- Hamerly	34	72	55	17	1,700	2.3
16---------- Hamerly-Wyard	33	70	54	17	1,650	2.5
18---------- Hamerly-Svea	35	74	57	18	1,750	2.5
23B---------- Barnes-Svea	32	68	52	16	1,600	2.6
23C---------- Barnes-Buse	23	49	37	12	1,150	2.2
23D---------- Barnes-Buse	12	26	20	6	600	2.1
23F Buse-Svea						
24---------- Svea-Barnes	36	77	59	18	1,800	2.7
24B---------- Svea-Buse	28	60	46	14	1,430	2.1
24E---------- Barnes-Svea-Buse	---	---	---	---	---	2.3
25E Barnes-Buse-Parnell						
30C---------- Svea-Sioux	20	43	33	10	1,000	1.9

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Sunflowers	Bromegrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
30E. Sioux-Barnes						
39F. Kloten-Buse						
40---------- Divide-Marysland	23	49	37	12	1,150	2.5
41---------- Fordville-Renshaw	23	49	37	12	1,150	2.3
41B---------- Fordville-Renshaw	19	40	31	10	950	2.0
44---------- Arvilla-Sioux	14	30	23	7	700	1.5
44C---------- Sioux-Arvilla	---	---	---	---	---	1.2
44E. Sioux-Arvilla						
47B---------- Renshaw-Sioux	14	30	23	7	700	1.5
48B---------- Maddock	17	36	28	9	850	1.8
48D---------- Maddock	---	---	---	---	---	1.8
49---------- Wyndmere	27	57	44	14	1,350	2.3
50---------- Fossum	8	17	13	4	400	2.8
51---------- Arveson	8	17	13	4	400	2.1
52---------- Hecla-Ulen	20	43	33	10	1,000	1.9
54B---------- Hecla-Towner	21	45	34	11	1,050	1.8
55---------- Towner	22	47	36	11	1,100	1.8
56---------- Swenoda	30	64	49	15	1,500	2.1
56B---------- Swenoda-Buse	25	53	41	13	1,250	1.9
56C---------- Swenoda-Buse	19	40	31	10	950	1.9

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Sunflowers	Bromegrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
57B---------- Embden	26	55	42	13	1,300	2.1
58B---------- Clontarf	22	47	36	11	1,100	2.1
60---------- Hamerly-Cresbard	31	66	50	16	1,550	2.0
61B---------- Swenoda-Larson	23	49	37	12	1,150	2.0
62---------- Svea-Cresbard	34	72	55	17	1,700	2.3
62B---------- Barnes-Cresbard	28	60	46	14	1,400	2.3
63---------- Cresbard-Cavour	25	53	41	13	1,250	1.5
64---------- Cavour-Miranda	13	28	21	7	650	1.0
66---------- Exline	---	---	---	---	---	0.9
70---------- Colvin	4	9	7	2	200	2.8
72---------- Minnewaukan	7	15	11	4	350	2.8
73---------- Overly-Bearden	38	81	62	19	1,900	2.5
73B---------- Great Bend-Overly	32	68	52	16	1,600	2.3
74---------- Aberdeen	27	57	44	14	1,350	1.6
76---------- Fargo-Colvin	16	34	26	8	800	2.8
77---------- Colvin	16	34	26	8	800	2.8
79B---------- Sinai	33	70	54	17	1,650	2.2
88C. Seelyeville						
90---------- Lamoure	16	34	26	8	800	2.8
92---------- La Prairie and Lamoure	---	---	---	---	---	2.8

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Sunflowers	Bromegrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
93---------- La Prairie	40	85	65	20	2,000	2.8
94---------- Darnen	39	83	63	20	1,950	2.8
94B---------- Darnen	34	72	55	17	1,700	2.6
100*. Pits						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
1 Southam	None assigned	---	---	---
2 Parnell	Wetland	7,000	6,600	6,000
3 Tonka	Wet Meadow	5,000	4,500	4,000
4*:				
Hamerly	Limy Subirrigated	4,800	4,200	3,600
Parnell	Wetland	7,000	6,600	6,000
5*:				
Hamerly	Limy Subirrigated	4,800	4,200	3,600
Tonka	Wet Meadow	5,000	4,500	4,000
13*:				
Hamerly	Saline Lowland	3,500	3,200	2,800
Vallers	Saline Lowland	4,000	3,500	3,000
Colvin	Saline Lowland	3,500	3,200	2,800
15 Hamerly	Limy Subirrigated	4,800	4,200	3,600
16*:				
Hamerly	Limy Subirrigated	4,800	4,200	3,600
Wyard	Overflow	4,000	3,600	3,100
18*:				
Hamerly	Limy Subirrigated	4,800	4,200	3,600
Svea	Overflow	4,000	3,600	3,100
23B*:				
Barnes	Silty	3,200	2,700	2,300
Svea	Silty	3,500	3,000	2,600
23C*, 23D*:				
Barnes	Silty	3,200	2,700	2,300
Buse	Thin Upland	2,800	2,500	2,100
23F*:				
Buse	Thin Upland	2,800	2,500	2,100
Svea	Silty	3,400	2,900	2,500

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
24*:				
Svea	Overflow	4,000	3,600	3,100
Barnes	Silty	3,200	2,700	2,300
24B*:				
Svea	Silty	3,500	3,000	2,600
Buse	Thin Upland	2,800	2,500	2,100
24E*:				
Barnes	Silty	3,200	2,700	2,300
Svea	Silty	3,400	2,900	2,500
Buse	Thin Upland	2,800	2,500	2,100
25E*:				
Barnes	Silty	3,200	2,700	2,300
Buse	Thin Upland	2,800	2,500	2,100
Parnell	Wetland	7,000	6,600	6,000
30C*:				
Svea	Silty	3,400	2,900	2,500
Sioux	Very Shallow	1,200	1,000	800
30E*:				
Sioux	Very Shallow	1,200	1,000	800
Barnes	Silty	3,200	2,700	2,300
39F*:				
Kloten	Shallow	2,300	2,000	1,700
Buse	Thin Upland	2,800	2,500	2,100
40*:				
Divide	Limy Subirrigated	4,800	4,200	3,600
Marysland	Subirrigated	4,800	4,400	3,900
41*, 41B*:				
Fordville	Silty	3,100	2,600	2,200
Renshaw	Shallow to Gravel	2,100	1,900	1,600
44*:				
Arvilla	Shallow to Gravel	2,100	1,900	1,600
Sioux	Very Shallow	1,200	1,000	800
44C*, 44E*:				
Sioux	Very Shallow	1,200	1,000	800
Arvilla	Shallow to Gravel	2,100	1,900	1,600

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
47B*:				
Renshaw	Shallow to Gravel	2,100	1,900	1,600
Sioux	Very Shallow	1,200	1,000	800
48B, 48D	Sands	3,300	2,900	2,500
Maddock				
49	Limy Subirrigated	4,800	4,200	3,600
Wyndmere				
50	Subirrigated	5,000	4,500	4,000
Fossum				
51	Saline Lowland	4,000	3,500	3,000
Arveson				
52*:				
Hecla	Sands	3,300	2,900	2,500
Ulen	Limy Subirrigated	4,800	4,200	3,600
54B*:				
Hecla	Sands	3,300	2,900	2,500
Towner	Sands	3,300	2,900	2,500
55	Sands	3,300	2,900	2,500
Towner				
56	Sandy	3,200	2,800	2,400
Swenoda				
56B*, 56C*:				
Swenoda	Sandy	3,200	2,800	2,400
Buse	Thin Upland	2,800	2,500	2,100
57B	Sandy	3,200	2,800	2,400
Embden				
58B	Sandy	3,200	2,800	2,400
Clontarf				
60*:				
Hamerly	Limy Subirrigated	4,800	4,200	3,600
Cresbard	Clayey	2,800	2,400	2,000
61B*:				
Swenoda	Sandy	3,200	2,800	2,400
Larson	Claypan	2,300	2,000	1,600
62*:				
Svea	Overflow	4,000	3,600	3,100
Cresbard	Clayey	2,800	2,400	2,000

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
62B*:				
Barnes	Silty	3,200	2,700	2,300
Cresbard	Clayey	2,800	2,400	2,000
63*:				
Cresbard	Clayey	2,800	2,400	2,000
Cavour	Claypan	2,300	2,000	1,600
64*:				
Cavour	Claypan	2,300	2,000	1,600
Miranda	Thin Claypan	1,300	1,100	900
66 Exline	Thin Claypan	1,300	1,100	900
70 Colvin	Wetland	7,000	6,600	6,000
72 Minnewaukan	Subirrigated	4,800	4,400	3,900
73*:				
Overly	Silty	3,400	2,900	2,500
Bearden	Limy Subirrigated	4,800	4,200	3,600
73B*:				
Great Bend	Silty	3,200	2,700	2,300
Overly	Silty	3,400	2,900	2,500
74 Aberdeen	Clayey	2,800	2,400	2,000
76*:				
Fargo	Clayey	3,200	2,800	2,400
Colvin	Subirrigated	5,000	4,500	4,000
77 Colvin	Subirrigated	5,000	4,500	4,000
79B Sinai	Clayey	3,100	2,700	2,300
88C Seelyeville	None assigned	---	---	---
90 Lamoure	Subirrigated	4,800	4,400	3,900
92*:				
La Prairie	Overflow	4,200	3,700	3,200
Lamoure	Subirrigated	6,400	5,800	4,600

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
93 La Prairie	Silty	3,500	3,000	2,600
94 Darnen	Overflow	4,000	3,600	3,100
94B Darnen	Silty	3,000	2,700	2,300
100* Pits	None assigned	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1. Southam					
2---------- Parnell	American plum-----	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
3---------- Tonka	---	Eastern redcedar, common chokecherry, lilac, American plum, redosier dogwood, Siberian peashrub.	Green ash, Siberian crabapple, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
4*:					
Hamerly----------	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
Parnell----------	American plum-----	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
5*:					
Hamerly----------	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
Tonka----------	---	Eastern redcedar, common chokecherry, lilac, American plum, redosier dogwood, Siberian peashrub.	Green ash, Siberian crabapple, Black Hills spruce.	Golden willow-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
13*:					
Hamerly	Silver buffaloberry, Siberian peashrub.	---	Siberian elm, Russian-olive, green ash.	---	---
Vallers	Siberian peashrub, silver buffaloberry.	---	Siberian elm, green ash, Russian-olive.	---	---
Colvin	Silver buffaloberry, Siberian peashrub.	---	Russian-olive, green ash, Siberian elm.	---	---
15-- Hamerly	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
16*:					
Hamerly	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
Wyard	---	Siberian peashrub, ponderosa pine, American plum, Peking cotoneaster, eastern redcedar, redosier dogwood, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
18*:					
Hamerly	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
18*:					
Svea	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow	Eastern cottonwood.
23B*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian-olive.	---	---
Svea	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow	Eastern cottonwood.
23C*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian-olive.	---	---
Buse	Siberian peashrub	Green ash, eastern redcedar, ponderosa pine, Russian-olive, Rocky Mountain juniper.	Siberian elm	---	---
23D*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian-olive.	---	---
Buse.					
23F*:					
Buse.					
Svea.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
24*:					
Svea	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow	Eastern cottonwood.
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian-olive.	---	---
24B*:					
Svea	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow	Eastern cottonwood.
Buse	Siberian peashrub	Green ash, eastern redcedar, ponderosa pine, Russian-olive, Rocky Mountain juniper.	Siberian elm	---	---
24E*:					
Barnes.					
Svea.					
Buse.					
25E*:					
Barnes.					
Buse.					
Parnell	American plum	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
30C*:					
Svea	---	Lilac, Siberian peashrub, redosier dogwood, eastern redcedar, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine, Black Hills spruce, Russian-olive.	---	---
Sioux.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
30E*:					
Sioux.					
Barnes.					
39F*:					
Kloten.					
Buse.					
40*:					
Divide	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
Marysland	---	Redosier dogwood, eastern redcedar, American plum, lilac, common chokecherry, Siberian peashrub.	Black Hills spruce, Siberian crabapple, green ash.	Golden willow	Eastern cottonwood.
41*, 41B*:					
Fordville	Lilac, Siberian peashrub, silver buffaloberry.	Siberian crabapple, common chokecherry, green ash, eastern redcedar, Russian-olive, Rocky Mountain juniper.	Ponderosa pine	---	---
Renshaw	Silver buffaloberry, Siberian peashrub, lilac.	Green ash, eastern redcedar, Siberian crabapple, common chokecherry, Rocky Mountain juniper.	Ponderosa pine, Russian-olive.	---	---
44*:					
Arvilla	Silver buffaloberry, Siberian peashrub, lilac.	Green ash, Russian-olive, Siberian crabapple, eastern redcedar, Rocky Mountain juniper, common chokecherry.	Ponderosa pine	---	---
Sioux.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
44C*: Sioux.					
Arvilla	Silver buffaloberry, Siberian peashrub, lilac.	Green ash, Russian-olive, Siberian crabapple, eastern redcedar, Rocky Mountain juniper, common chokecherry.	Ponderosa pine	---	---
44E*: Arvilla.					
47B*: Renshaw	Silver buffaloberry, Siberian peashrub, lilac.	Green ash, eastern redcedar, Rocky Mountain juniper, Siberian crabapple, common chokecherry.	Ponderosa pine, Russian-olive.	---	---
Sioux.					
48B Maddock	---	Silver buffaloberry, common chokecherry, Siberian peashrub, eastern redcedar, lilac, American plum, Siberian crabapple.	Bur oak, green ash, ponderosa pine, Russian-olive.	---	---
48D. Maddock					
49 Wyndmere	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, Tatarian honeysuckle, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
50 Fossum	American plum	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
51---------- Arveson	Siberian peashrub, silver buffaloberry.	---	Siberian elm, green ash, Russian-olive.	---	---
52*:					
Hecla----------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
Ulen----------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
54B*:					
Hecla----------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
Towner----------	---	Lilac, eastern redcedar, Siberian peashrub, common chokecherry, Siberian crabapple, American plum, silver buffaloberry.	Ponderosa pine, green ash, Russian-olive, bur oak.	---	---
55---------- Towner	---	Lilac, eastern redcedar, Siberian peashrub, common chokecherry, Siberian crabapple, American plum, silver buffaloberry.	Ponderosa pine, green ash, Russian-olive, bur oak.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
56---------- Swenoda	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
56B*: Swenoda----------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
Buse----------	Siberian peashrub	Green ash, eastern redcedar, ponderosa pine, Russian-olive, Rocky Mountain juniper.	Siberian elm------	---	---
56C*: Swenoda----------	---	Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, silver buffaloberry, American plum, lilac.	Green ash, bur oak, ponderosa pine, Russian-olive.	---	---
Buse----------	Siberian peashrub	Green ash, eastern redcedar, ponderosa pine, Russian-olive, Rocky Mountain juniper.	Siberian elm------	---	---
57B---------- Embden	---	Peking cotoneaster, ponderosa pine, eastern redcedar, redosier dogwood, common chokecherry, Siberian peashrub, American plum.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
58B---------- Clontarf	---	Common chokecherry, Siberian peashrub, eastern redcedar, American plum, silver buffaloberry, Siberian crabapple, lilac.	Green ash, bur oak, ponderosa pine, Russian-olive.	---	---
60*:					
Hamerly----------	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
Cresbard---------	Peking cotoneaster	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
61B*:					
Swenoda----------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
Larson----------	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian-olive, eastern redcedar.	---	---	---
62*:					
Svea----------	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
62*:					
Cresbard	Peking cotoneaster	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
62B*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian-olive.	---	---
Cresbard	Peking cotoneaster	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
63*:					
Cresbard	Peking cotoneaster	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
Cavour	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian-olive, eastern redcedar.	---	---	---
64*:					
Cavour	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian-olive, eastern redcedar.	---	---	---
Miranda.					
66.					
Exline					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
70---------- Colvin	---	American plum, Siberian peashrub, eastern redcedar, redosier dogwood, lilac.	Green ash, Black Hills spruce, Siberian crabapple.	Golden willow-----	Eastern cottonwood, Siberian elm.
72---------- Minnewaukan	American plum-----	Lilac, Siberian peashrub, eastern redcedar, redosier dogwood, common chokecherry.	Siberian crabapple, green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
73*:					
Overly----------	---	Siberian peashrub, ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
Bearden----------	---	Redosier dogwood, ponderosa pine, eastern redcedar, common chokecherry, Siberian peashrub, Peking cotoneaster, American plum.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
73B*:					
Great Bend-------	---	Eastern redcedar, redosier dogwood, American plum, Siberian peashrub, lilac.	Ponderosa pine, Black Hills spruce, green ash, Russiian-olive, bur oak, Siberian crabapple.	---	---
Overly----------	---	Siberian peashrub, ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
74---------- Aberdeen	---	Eastern redcedar, Siberian peashrub, Russian-olive, lilac, Peking cotoneaster, common chokecherry, silver buffaloberry.	Siberian elm, Siberian crabapple, green ash, ponderosa pine.	---	---
76*:					
Fargo----------	American plum-----	Eastern redcedar, lilac, common chokecherry, redosier dogwood, Siberian peashrub.	Green ash, Siberian crabapple, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
Colvin----------	---	American plum, Siberian peashrub, common chokecherry, lilac, eastern redcedar, redosier dogwood.	Green ash, Black Hills spruce, Siberian crabapple.	Golden willow-----	Eastern cottonwood.
77---------- Colvin	---	American plum, Siberian peashrub, common chokecherry, lilac, eastern redcedar, redosier dogwood.	Green ash, Black Hills spruce, Siberian crabapple.	Golden willow-----	Eastern cottonwood.
79B---------- Sinai	---	Eastern redcedar, Siberian peashrub, Russian-olive, lilac, Peking cotoneaster, common chokecherry, silver buffaloberry.	Siberian elm, Siberian crabapple, green ash, ponderosa pine.	---	---
88C. Seelyeville					
90---------- Lamoure	American plum-----	Eastern redcedar, redosier dogwood, Siberian peashrub, lilac, common chokecherry.	Green ash, Black Hills spruce, Manchurian crabapple.	Golden willow-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
92*: La Prairie	---	Ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
Lamoure	American plum	Eastern redcedar, redosier dogwood, Siberian peashrub, lilac, common chokecherry.	Green ash, Black Hills spruce, Manchurian crabapple.	Golden willow	Eastern cottonwood.
93-- La Prairie	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, Tatarian honeysuckle, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
94, 94B-- Darnen	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
100*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1 Southam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
2 Parnell	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
3 Tonka	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
4*: Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Parnell	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
5*: Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Tonka	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
13*: Hamerly	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
Vallers	Severe: flooding, wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness.
Colvin	Severe: flooding, wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness.
15 Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
16*: Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Wyard	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
18*: Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
18*:				
Svea	Slight	Slight	Moderate: small stones.	Slight.
23B*:				
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight.
Svea	Slight	Slight	Moderate: slope, small stones.	Slight.
23C*:				
Barnes	Slight	Slight	Severe: slope.	Slight.
Buse	Slight	Slight	Severe: slope.	Slight.
23D*:				
Barnes	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Buse	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
23F*:				
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Svea	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
24*:				
Svea	Slight	Slight	Moderate: small stones.	Slight.
Barnes	Slight	Slight	Moderate: small stones.	Slight.
24B*:				
Svea	Slight	Slight	Moderate: slope, small stones.	Slight.
Buse	Slight	Slight	Moderate: slope, small stones.	Slight.
24E*:				
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Svea	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
25E*:				
Barnes	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Parnell	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
30C*:				
Svea	Slight	Slight	Severe: slope.	Slight.
Sioux	Slight	Slight	Severe: slope.	Slight.
30E*:				
Sioux	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
39F*:				
Kloten	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
40*:				
Divide	Slight	Slight	Slight	Slight.
Marysland	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
41*:				
Fordville	Slight	Slight	Slight	Slight.
Renshaw	Slight	Slight	Slight	Slight.
41B*:				
Fordville	Slight	Slight	Moderate: slope.	Slight.
Renshaw	Slight	Slight	Moderate: slope.	Slight.
44*:				
Arvilla	Slight	Slight	Slight	Slight.
Sioux	Slight	Slight	Moderate: slope, small stones.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
44C*:				
Sioux	Slight	Slight	Moderate: slope, small stones.	Slight.
Arvilla	Slight	Slight	Moderate: slope.	Slight.
44E*:				
Sioux	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Arvilla	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
47B*:				
Renshaw	Slight	Slight	Moderate: slope.	Slight.
Sioux	Slight	Slight	Moderate: slope, small stones.	Slight.
48B--- Maddock	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
48D--- Maddock	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
49--- Wyndmere	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
50--- Fossum	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
51--- Arveson	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness.
52*:				
Hecla	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Ulen	Slight	Slight	Slight	Slight.
54B*:				
Hecla	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
Towner	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
55--- Towner	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
56---------- Swenoda	Slight----------	Slight----------	Slight----------	Slight.
56B*:				
Swenoda----------	Slight----------	Slight----------	Moderate: slope.	Slight.
Buse----------	Slight----------	Slight----------	Moderate: slope, small stones.	Slight.
56C*:				
Swenoda----------	Slight----------	Slight----------	Severe: slope.	Slight.
Buse----------	Slight----------	Slight----------	Severe: slope.	Slight.
57B---------- Embden	Slight----------	Slight----------	Moderate: slope.	Slight.
58B---------- Clontarf	Slight----------	Slight----------	Moderate: slope.	Slight.
60*:				
Hamerly----------	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Cresbard----------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
61B*:				
Swenoda----------	Slight----------	Slight----------	Moderate: slope.	Slight.
Larson----------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
62*:				
Svea----------	Slight----------	Slight----------	Moderate: small stones.	Slight.
Cresbard----------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
62B*:				
Barnes----------	Slight----------	Slight----------	Moderate: slope, small stones.	Slight.
Cresbard----------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
63*:				
Cresbard----------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Cavour----------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
64*:				
Cavour	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Miranda	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
66 Exline	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
70 Colvin	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
72 Minnewaukan	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
73*:				
Overly	Slight	Slight	Slight	Slight.
Bearden	Moderate: wetness.	Moderate: wetness, percs slowly.	Moderate: wetness.	Slight.
73B*:				
Great Bend	Slight	Slight	Moderate: slope.	Slight.
Overly	Slight	Slight	Moderate: slope.	Slight.
74 Aberdeen	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
76*:				
Fargo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
77 Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
79B Sinai	Slight	Slight	Moderate: slope.	Slight.
88C Seelyeville	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.
90 Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
92*:				
La Prairie	Severe: flooding.	Slight	Moderate: flooding.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
92*: Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
93 La Prairie	Severe: flooding.	Slight	Slight	Slight.
94 Darnen	Slight	Slight	Slight	Slight.
94B Darnen	Slight	Slight	Moderate: slope.	Slight.
100*. Pits				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1--Southam	Very poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Good	Very poor.
2--Parnell	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
3--Tonka	Poor	Fair	Fair	Poor	Good	Good	Poor	Good	Poor.
4*:									
Hamerly	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Parnell	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
5*:									
Hamerly	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Tonka	Poor	Fair	Fair	Poor	Good	Good	Poor	Good	Poor.
13*:									
Hamerly	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair	Fair.
Vallers	Poor	Fair	Very poor	Very poor	Good	Good	Poor	Good	Very poor.
Colvin	Poor	Fair	Poor	Fair	Good	Good	Poor	Good	Poor.
15--Hamerly	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
16*:									
Hamerly	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Wyard	Good	Good	Good	Good	Fair	Fair	Good	Fair	Good.
18*:									
Hamerly	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Svea	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
23B*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Svea	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
23C*:									
Barnes	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Buse	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
23D*:									
Barnes	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Buse	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
23F*:									
Buse	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Svea	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
24*:									
Svea	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
24B*:									
Svea	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Buse	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
24E*:									
Barnes	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Svea	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Buse	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
25E*:									
Barnes	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Buse	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Parnell	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
30C*:									
Svea	Fair	Good	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
30E*:									
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Barnes	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
39F*:									
Kloten	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Buse	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
40*:									
Divide	Fair	Fair	Good	Fair	Fair	Very poor	Fair	Poor	Fair.
Marysland	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
41*:									
Fordville	Good	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Renshaw	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
41B*:									
Fordville	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Renshaw	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
44*:									
Arvilla	Fair	Good	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
44C*:									
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Arvilla	Fair	Good	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
44E*:									
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Arvilla	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
47B*:									
Renshaw	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
48B---------- Maddock	Fair	Good	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
48D---------- Maddock	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
49---------- Wyndmere	Fair	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
50---------- Fossum	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
51---------- Arveson	Poor	Fair	Very poor	Very poor	Good	Good	Poor	Good	Very poor.
52*:									
Hecla	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Ulen	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
54B*:									
Hecla	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Towner	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
55---------- Towner	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
56---------- Swenoda	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
56B*:									
Swenoda	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Buse	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
56C*:									
Swenoda	Poor	Fair	Good	---	Very poor	Very poor	Fair	Very poor	Good.
Buse	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
57B	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Embden									
58B	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Clontarf									
60*:									
Hamerly	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Cresbard	Good	Fair	Good	Poor	Very poor	Very poor	Good	Very poor	Good.
61B*:									
Swenoda	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Larson	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
62*:									
Svea	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Cresbard	Good	Fair	Good	Poor	Very poor	Very poor	Good	Very poor	Good.
62B*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cresbard	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.
63*:									
Cresbard	Good	Fair	Good	Poor	Very poor	Very poor	Good	Very poor	Good.
Cavour	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
64*:									
Cavour	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Miranda	Poor	Poor	Very poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
66	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Poor	Fair.
Exline									
70	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
Colvin									
72	Poor	Poor	Fair	Fair	Fair	Very poor	Poor	Poor	Fair.
Minnewaukan									
73*:									
Overly	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Bearden	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
73B*:									
Great Bend	Good	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Overly	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
74 Aberdeen	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Fair.
76*:									
Fargo	Good	Good	Fair	Poor	Good	Good	Fair	Good	Poor.
Colvin	Poor	Fair	Fair	Fair	Good	Good	Poor	Good	Fair.
77 Colvin	Poor	Fair	Fair	Fair	Good	Good	Poor	Good	Fair.
79B Sinai	Good	Good	Fair	Poor	Very poor	Very poor	Good	Very poor	Poor.
88C Seelyeville	Poor	Poor	Poor	---	Good	Fair	Poor	Fair	---
90 Lamoure	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
92*:									
La Prairie	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Lamoure	Very poor	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Fair.
93 La Prairie	Good	Good	Fair	---	Very poor	Very poor	Good	Very poor	Fair.
94 Darnen	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
94B Darnen	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
100*. Pits									

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1 Southam	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
2 Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
3 Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
4*:					
Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
5*:					
Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
13*:					
Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
Vallers	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, frost action.
Colvin	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness.
15 Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
16*:					
Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
Wyard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.
18*:					
Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength.
23B*:					
Barnes	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope.	Severe: low strength.
23C*:					
Barnes	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
Buse	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
23D*:					
Barnes	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.
Buse	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.
23F*:					
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Svea	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
24*:					
Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
24*:					
Barnes	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.
24B*:					
Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope.	Severe: low strength.
Buse	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
24E*:					
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Svea	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
25E*:					
Barnes	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
30C*:					
Svea	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Sioux	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
30E*:					
Sioux	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
39F*:					
Kloten	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
40*:					
Divide	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
Marysland	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.
41*:					
Fordville	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Renshaw	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
41B*:					
Fordville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Renshaw	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
44*:					
Arvilla	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Sioux	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
44C*:					
Sioux	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Arvilla	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
44E*:					
Sioux	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Arvilla	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
47B*:					
Renshaw	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Sioux	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
48B Maddock	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
48D Maddock	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
49 Wyndmere	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
50---- Fossum	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.
51---- Arveson	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.
52*:					
Hecla----	Severe: cutbanks cave.	Slight----	Moderate: wetness.	Slight----	Moderate: frost action.
Ulen----	Severe: cutbanks cave.	Slight----	Moderate: wetness.	Slight----	Moderate: frost action.
54B*:					
Hecla----	Severe: cutbanks cave.	Slight----	Moderate: wetness.	Slight----	Moderate: frost action.
Towner----	Severe: cutbanks cave.	Slight----	Moderate: wetness, shrink-swell.	Slight----	Moderate: frost action.
55---- Towner	Severe: cutbanks cave.	Slight----	Moderate: wetness, shrink-swell.	Slight----	Moderate: frost action.
56---- Swenoda	Moderate: wetness.	Slight----	Moderate: wetness, shrink-swell.	Slight----	Moderate: frost action.
56B*:					
Swenoda----	Moderate: wetness.	Slight----	Moderate: wetness, shrink-swell.	Moderate: slope.	Moderate: frost action.
Buse----	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
56C*:					
Swenoda----	Slight----	Slight----	Moderate: shrink-swell.	Moderate: slope.	Moderate: frost action.
Buse----	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
57B---- Embden	Severe: cutbanks cave.	Slight----	Moderate: wetness.	Slight----	Moderate: frost action.
58B---- Clontarf	Severe: cutbanks cave.	Slight----	Slight----	Slight----	Moderate: frost action.
60*:					
Hamerly----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
60*:					
Cresbard	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
61B*:					
Swenoda	Moderate: wetness.	Slight	Moderate: wetness, shrink-swell.	Slight	Moderate: frost action.
Larson	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
62*:					
Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength.
Cresbard	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
62B*:					
Barnes	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
Cresbard	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
63*:					
Cresbard	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Cavour	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
64*:					
Cavour	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Miranda	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, low strength, wetness.
66 Exline	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
70 Colvin	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
72---------- Minnewaukan	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.
73*:					
Overly----------	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Bearden----------	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.
73B*:					
Great Bend-------	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Severe: low strength, frost action.
Overly----------	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
74---------- Aberdeen	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
76*:					
Fargo----------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
Colvin----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.
77---------- Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.
79B---------- Sinai	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
88C---------- Seelyeville	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness.	Severe: subsides, wetness, frost action.
90---------- Lamoure	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.
92*:					
La Prairie-------	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
92*: Lamoure	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.
93--- La Prairie	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, low strength, flooding.
94, 94B--- Darnen	Severe: excess humus.	Severe: low strength.	Moderate: shrink-swell.	Severe: low strength.	Moderate: frost action.
100*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1--- Southam	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
2--- Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
3--- Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
4*:					
Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
5*:					
Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
13*:					
Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Vallers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Colvin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
15--- Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
16*:					
Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Wyard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
18*:					
Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Svea	Severe: percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
23B*:					
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Svea	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
23C*:					
Barnes	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Buse	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
23D*:					
Barnes	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Buse	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
23F*:					
Buse	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Svea	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
24*:					
Svea	Severe: percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Barnes	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
24B*:					
Svea	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Buse	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
24E*:					
Barnes	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Svea	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Buse	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
25E*:					
Barnes	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Buse	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
30C*:					
Svea	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Sioux	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
30E*:					
Sioux	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Barnes	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
39F*:					
Kloten	Severe: seepage, thin layer, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: thin layer, slope, area reclaim.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
39F*:					
Buse	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
40*:					
Divide	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Marysland	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
41*, 41B*:					
Fordville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Renshaw	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
44*:					
Arvilla	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Sioux	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
44C*:					
Sioux	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Arvilla	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
44E*:					
Sioux	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Arvilla	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
47B*:					
Renshaw	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Sioux	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
48B	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
48D	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
49	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy.
50	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
51	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
52*:					
Hecla	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, seepage.
Ulen	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
54B*:					
Hecla	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, seepage.
Towner	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
55	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
56---------- Swenoda	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
56B*:					
Swenoda----------	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
Buse----------	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
56C*:					
Swenoda----------	Severe: percs slowly.	Severe: seepage, slope.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
Buse----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
57B*: Embden	Moderate: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Fair: too sandy.
58B---------- Clontarf	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
60*:					
Hamerly----------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Cresbard----------	Severe: percs slowly.	Moderate: wetness.	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
61B*:					
Swenoda----------	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
Larson----------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, excess sodium.	Severe: wetness.	Poor: excess sodium.
62*:					
Svea----------	Severe: percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Cresbard----------	Severe: percs slowly.	Moderate: wetness.	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
62B*:					
Barnes----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
62B*:					
Cresbard	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
63*:					
Cresbard	Severe: percs slowly.	Moderate: wetness.	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
Cavour	Severe: percs slowly.	Slight	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
64*:					
Cavour	Severe: percs slowly.	Slight	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
Miranda	Severe: wetness, percs slowly.	Slight	Severe: wetness, excess sodium.	Severe: wetness.	Poor: excess sodium.
66--- Exline	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey, too sandy.	Severe: wetness.	Poor: too clayey, hard to pack, excess sodium.
70--- Colvin	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
72--- Minnewaukan	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
73*:					
Overly	Severe: percs slowly.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Poor: thin layer.
Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
73B*:					
Great Bend	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, thin layer.
Overly	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness.	Moderate: wetness.	Poor: thin layer.
74--- Aberdeen	Severe: percs slowly.	Moderate: seepage.	Severe: wetness, too clayey, too sandy.	Moderate: wetness.	Poor: too clayey, excess sodium.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
76*:					
Fargo	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Colvin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
77 Colvin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
79B Sinai	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
88C Seelyeville	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
90 Lamoure	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
92*:					
La Prairie	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Fair: too clayey.
Lamoure	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
93 La Prairie	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
94 Darnen	Moderate: percs slowly.	Moderate: seepage, excess humus.	Moderate: too clayey.	Slight	Fair: too clayey.
94B Darnen	Moderate: percs slowly.	Moderate: seepage, slope, excess humus.	Moderate: too clayey.	Slight	Fair: too clayey.
100* Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1--- Southam	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
2--- Parnell	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
3--- Tonka	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
4*:				
Hamerly---	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Parnell---	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
5*:				
Hamerly---	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Tonka---	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
13*:				
Hamerly---	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Vallers---	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
Colvin---	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
15--- Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
16*:				
Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Wyard	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
18*:				
Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
23B*:				
Barnes	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
23C*:				
Barnes	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Buse	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
23D*:				
Barnes	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Buse	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
23F*:				
Buse	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
24*:				
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24*:				
Barnes	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
24B*:				
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Buse	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
24E*:				
Barnes	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Buse	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
25E*:				
Barnes	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Buse	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Parnell	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
30C*:				
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Sioux	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
30E*:				
Sioux	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
30E*:				
Barnes	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
39F*:				
Kloten	Poor: area reclaim, slope, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Buse	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
40*:				
Divide	Fair: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Marysland	Poor: wetness.	Probable	Probable	Poor: wetness.
41*, 41B*:				
Fordville	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Renshaw	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
44*:				
Arvilla	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Sioux	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
44C*:				
Sioux	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Arvilla	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
44E*:				
Sioux	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Arvilla	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
47B*:				
Renshaw	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Sioux	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
48B, 48D Maddock	Good	Probable	Improbable: too sandy.	Poor: too sandy.
49 Wyndmere	Fair: thin layer, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
50 Fossum	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
51 Arveson	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess salt, wetness.
52*:				
Hecla	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Ulen	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
54B*:				
Hecla	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Towner	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
55 Towner	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
56 Swenoda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
56B*, 56C*:				
Swenoda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
56B*, 56C*:				
Buse	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
57B Embden	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
58B Clontarf	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
60*:				
Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Cresbard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
61B*:				
Swenoda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Larson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, excess sodium.
62*:				
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Cresbard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
62B*:				
Barnes	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Cresbard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
63*:				
Cresbard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
64*:				
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Miranda	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
66 Exline	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
70 Colvin	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
72 Minnewaukan	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, small stones, wetness.
73*:				
Overly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Bearden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
73B*:				
Great Bend	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Overly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
74 Aberdeen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
76*:				
Fargo	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Colvin	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
77 Colvin	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
79B Sinai	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
88C---------- Seelyeville	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
90---------- Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
92*:				
La Prairie----------	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Lamoure----------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
93---------- La Prairie	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
94, 94B---------- Darnen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
100*. Pits				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1---------- Southam	Slight---------	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, excess salt, erodes easily.
2---------- Parnell	Slight---------	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
3---------- Tonka	Slight---------	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
4*: Hamerly----------	Slight---------	Severe: piping.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
Parnell----------	Slight---------	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
5*: Hamerly----------	Slight---------	Severe: piping.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
Tonka----------	Slight---------	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
13*: Hamerly----------	Slight---------	Severe: piping.	Frost action, excess salt.	Wetness, excess salt.	Erodes easily, wetness.	Excess salt, erodes easily.
Vallers----------	Slight---------	Severe: piping, wetness.	Frost action, excess salt.	Wetness, excess salt.	Wetness--------	Wetness, excess salt.
Colvin----------	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, excess salt, percs slowly.
15---------- Hamerly	Slight---------	Severe: piping.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
16*: Hamerly----------	Slight---------	Severe: piping.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
Wyard----------	Moderate: seepage.	Severe: piping, wetness.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
18*: Hamerly----------	Slight---------	Severe: piping.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
18*:						
Svea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
23B*:						
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Svea	Moderate: slope, seepage.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
23C*:						
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Buse	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
23D*:						
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
23F*:						
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Svea	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
24*:						
Svea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Barnes	Slight	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
24B*:						
Svea	Moderate: slope, seepage.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Buse	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
24E*:						
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Svea	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
25E*:						
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Parnell	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
30C*:						
Svea	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Sioux	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty.	Too sandy	Droughty.
30E*:						
Sioux	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
39F*:						
Kloten	Severe: seepage, slope.	Severe: piping, thin layer.	Deep to water	Slope, thin layer.	Slope, area reclaim.	Slope, area reclaim.
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
40*:						
Divide	Severe: seepage.	Severe: seepage.	Cutbanks cave	Wetness	Wetness, too sandy.	Favorable.
Marysland	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
41*:						
Fordville	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth	Too sandy	Rooting depth.
Renshaw	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Too sandy	Droughty.
41B*:						
Fordville	Severe: seepage.	Severe: seepage.	Deep to water	Slope, rooting depth.	Too sandy	Rooting depth.
Renshaw	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
44*:						
Arvilla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
Sioux	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Too sandy, soil blowing.	Droughty.
44C*:						
Sioux	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
Arvilla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
44E*:						
Sioux	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty.
Arvilla	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
47B*:						
Renshaw	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty.	Too sandy	Droughty.
Sioux	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty.	Too sandy	Droughty.
48B Maddock	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
48D Maddock	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
49 Wyndmere	Severe: seepage.	Severe: piping.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy, soil blowing.	Favorable.
50 Fossum	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
51 Arveson	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave, excess salt.	Wetness, droughty.	Wetness, too sandy.	Wetness, excess salt, droughty.
52*:						
Hecla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
52*:						
Ulen	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
54B*:						
Hecla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Towner	Severe: seepage.	Severe: piping.	Deep to water	Slope, droughty, fast intake.	Erodes easily, soil blowing.	Erodes easily, droughty.
55--Towner	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake.	Erodes easily, soil blowing.	Erodes easily, droughty.
56--Swenoda	Severe: seepage.	Severe: piping.	Favorable	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
56B*:						
Swenoda	Severe: seepage.	Severe: piping.	Slope	Slope, wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
Buse	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
56C*:						
Swenoda	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Erodes easily, soil blowing.	Erodes easily.
Buse	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
57B--Embden	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing, slope.	Soil blowing	Favorable.
58B--Clontarf	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
60*:						
Hamerly	Slight	Severe: piping.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
Cresbard	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
61B*:						
Swenoda	Severe: seepage.	Severe: piping.	Slope	Slope, wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
Larson	Moderate: seepage, slope.	Severe: piping, excess sodium.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing	Excess sodium, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
62*:						
Svea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Cresbard	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
62B*:						
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Cresbard	Moderate: slope.	Severe: excess sodium.	Deep to water	Slope, percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
63*:						
Cresbard	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
Cavour	Slight	Severe: excess sodium.	Deep to water	Percs slowly, rooting depth.	Erodes easily, percs slowly.	Excess sodium, erodes easily, rooting depth.
64*:						
Cavour	Slight	Severe: excess sodium.	Deep to water	Percs slowly, rooting depth.	Erodes easily, percs slowly.	Excess sodium, erodes easily, rooting depth.
Miranda	Slight	Severe: piping, excess sodium.	Percs slowly, excess salt.	Wetness, percs slowly.	Wetness, percs slowly.	Excess sodium, percs slowly.
66 Exline	Slight	Severe: excess sodium.	Percs slowly, cutbanks cave, excess salt.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Excess sodium, erodes easily, percs slowly.
70 Colvin	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
72 Minnewaukan	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
73*:						
Overly	Slight	Severe: piping.	Deep to water	Percs slowly	Favorable	Percs slowly.
Bearden	Moderate: seepage.	Moderate: piping, hard to pack, wetness.	Percs slowly, frost action.	Wetness	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
73B*:						
Great Bend	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, percs slowly.	Erodes easily	Erodes easily.
Overly	Moderate: slope.	Severe: piping.	Deep to water	Slope, percs slowly.	Favorable	Percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
74---------- Aberdeen	Moderate: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
76*:						
Fargo----------	Slight----------	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
Colvin----------	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
77---------- Colvin	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
79B---------- Sinai	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
88C---------- Seelyeville	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action, slope.	Slope, wetness.	Wetness--------	Wetness.
90---------- Lamoure	Moderate: seepage.	Severe: hard to pack, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
92*:						
La Prairie-------	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Favorable------	Favorable.
Lamoure----------	Moderate: seepage.	Severe: hard to pack, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
93---------- La Prairie	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
94---------- Darnen	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
94B---------- Darnen	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
100* Pits						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
1----------	0-6	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-100	30-50	10-25
Southam	6-27	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	95-100	90-100	85-100	40-75	15-50
	27-60	Silty clay, silty clay loam, loam.	CL, CH, CL-ML	A-6, A-7, A-4	0	100	95-100	85-100	60-100	20-75	5-50
2----------	0-16	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
Parnell	16-36	Clay, silty clay loam, silty clay	CL, CH	A-7	0	100	95-100	90-100	70-100	40-80	20-50
	36-60	Clay loam, loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
3----------	0-22	Silt loam--------	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-35	5-15
Tonka	22-52	Silty clay loam, clay loam, silty clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	52-60	Silty clay loam, clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0-3	90-100	85-100	60-100	50-90	25-50	5-30
4*:											
Hamerly---------	0-9	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Parnell---------	0-16	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	16-36	Clay, silty clay loam, silty clay	CL, CH	A-7	0	100	95-100	90-100	70-100	40-80	20-50
	36-60	Clay loam, loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
5*:											
Hamerly---------	0-9	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Tonka----------	0-22	Silt loam--------	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-35	5-15
	22-52	Silty clay loam, clay loam, silty clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	52-60	Silty clay loam, clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0-3	90-100	85-100	60-100	50-90	25-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
13*:											
Hamerly	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	25-40	5-20
	9-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	25-45	5-20
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	25-45	5-20
Vallers	0-7	Silty clay loam	CL	A-6, A-7	0-5	95-100	95-100	95-100	85-95	30-50	10-20
	7-30	Clay loam, silty clay loam, loam.	CL	A-6	0-5	95-100	90-100	80-95	50-80	30-40	10-20
	30-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-75	20-40	5-20
Colvin	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	7-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	20-50	10-30
15 Hamerly	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
16*:											
Hamerly	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Wyard	0-25	Loam	CL-ML, CL	A-4, A-6, A-7	0	95-100	90-100	85-100	60-90	25-45	5-25
	25-60	Loam, clay loam.	ML, CL, SC, CL-ML	A-4, A-6, A-7	0-10	95-100	90-100	80-100	35-85	20-45	3-25
18*:											
Hamerly	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30
23B*:											
Barnes	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
23C*, 23D*:											
Barnes	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
23F*:											
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-50	5-30
24*:											
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30
Barnes	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
24B*:											
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
24E*:											
Barnes	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-50	5-30
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
25E*:											
Barnes	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
Parnell	0-16	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	16-36	Clay, silty clay loam, silty clay	CL, CH	A-7	0	100	95-100	90-100	70-100	40-80	20-50
	36-60	Clay loam, loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
30C*:											
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-50	5-30
Sioux	0-7	Loam	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	7-10	Gravelly loam, sandy loam, loamy sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	10-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
30E*:											
Sioux	0-7	Loam	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	7-10	Gravelly loam, sandy loam, loamy sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	10-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
Barnes	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
39F*:											
Kloten	0-6	Loam	CL, CL-ML	A-4, A-6	0-10	90-100	90-100	85-95	60-90	20-40	5-20
	6-10	Loam, silty clay loam, clay loam.	CL-ML, CL	A-4, A-6	0-10	90-100	80-100	70-95	60-90	20-40	5-20
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
40*:											
Divide	0-10	Loam	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-85	25-40	5-20
	10-22	Loam, clay loam, gravelly loam.	CL, CL-ML, SC-SM, SC	A-4, A-6, A-7	0-3	95-100	75-100	55-90	35-80	20-45	5-20
	22-60	Sand to gravelly sand.	GM, SM, GP-GM, SP-SM	A-1, A-3	0-5	25-100	15-100	10-70	5-25	<30	NP-5
Marysland	0-8	Loam	CL	A-6, A-7	0	95-100	95-100	85-95	50-80	30-50	10-25
	8-32	Loam, clay loam, sandy clay loam.	CL, SC	A-6	0	90-100	85-100	80-95	45-80	20-40	10-20
	32-60	Fine sand to gravelly coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	70-95	50-90	35-70	5-20	---	NP
41*, 41B*:											
Fordville	0-7	Loam	ML, CL	A-4, A-6, A-7	0	100	100	70-85	55-75	30-45	5-20
	7-27	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	70-95	55-80	30-45	5-20
	27-32	Loam, clay loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0	95-100	90-100	65-90	40-55	25-40	3-15
	32-60	Loamy sand, sand, gravelly sand.	SW, SW-SM, SM	A-1	0	65-95	45-90	15-45	0-15	<25	NP-5
Renshaw	0-7	Loam	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	7-15	Loam, sandy clay loam, gravelly loam.	SC-SM, SC, ML, CL	A-4, A-6	0-5	95-100	55-100	45-90	35-70	20-40	3-15
	15-60	Gravelly loamy sand, very gravelly loamy sand, gravelly sand.	SW, SM, SW-SM, GW-GM	A-1, A-2	0-5	45-95	30-80	10-60	0-15	<25	NP-5
44*:											
Arvilla	0-8	Sandy loam	SM, SC, SC-SM	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	8-18	Sandy loam, loam, coarse sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0	90-100	85-100	50-80	20-45	<40	NP-15
	18-60	Gravelly sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SM, GP-GM	A-1, A-2, A-3	0	35-100	25-100	10-60	0-15	---	NP
Sioux	0-7	Sandy loam	SM	A-4	0-5	95-100	85-100	60-85	35-45	20-30	NP-7
	7-10	Gravelly loam, sandy loam, loamy sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	10-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
44C*, 44E*:											
Sioux	0-7	Sandy loam	SM	A-4	0-5	95-100	85-100	60-85	35-45	20-30	NP-7
	7-10	Gravelly loam, sandy loam, loamy sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	10-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
Arvilla	0-8	Sandy loam	SM, SC, SC-SM	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	8-18	Sandy loam, loam, coarse sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0	90-100	85-100	50-80	20-45	<40	NP-15
	18-60	Gravelly sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SM, GP-GM	A-1, A-2, A-3	0	35-100	25-100	10-60	0-15	---	NP
47B*:											
Renshaw	0-7	Loam	ML	A-4	0-5	95-100	90-100	70-100	50-75	20-40	NP-10
	7-15	Loam, sandy clay loam, gravelly loam.	SC-SM, SC, ML, CL	A-4, A-6	0-5	95-100	55-100	45-90	35-70	20-40	3-15
	15-60	Gravelly loamy sand, very gravelly loamy sand, gravelly sand.	SW, SM, SW-SM, GW-GM	A-1, A-2	0-5	45-95	30-80	10-60	0-15	<25	NP-5
Sioux	0-7	Loam	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	7-10	Gravelly loam, gravelly sandy loam, loamy sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	10-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
48B, 48D	0-15	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
Maddock	15-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	60-100	5-35	---	NP
49	0-15	Fine sandy loam	SM, ML, SC, SC-SM	A-2, A-4	0	100	100	60-80	30-55	10-30	NP-10
Wyndmere		sandy loam.	SC, SC-SM								
	32-51	Fine sand, loamy fine sand, fine sandy loam.	SM, ML	A-2, A-4	0	100	100	60-100	20-55	---	NP
	51-60	Stratified loam and clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	85-100	75-100	55-90	20-45	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
50---------- Fossum	0-8	Fine sandy loam	SM, SC, SC-SM	A-4	0	100	100	60-85	35-50	<20	NP-10
	8-30	Loamy fine sand, sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	100	60-80	5-30	---	NP
	30-60	Sand, fine sand, loamy fine sand.	SP-SM, SM	A-3, A-2	0	95-100	95-100	60-100	5-20	---	NP
51---------- Arveson	0-24	Loam----------	ML	A-4	0-1	100	95-100	85-90	50-80	20-40	NP-10
	24-42	Fine sandy loam, sandy loam.	SM, SC-SM	A-4	0	100	95-100	60-85	35-50	<20	NP-5
	42-60	Sand, loamy sand, fine sandy loam.	SP-SM, SM, SC-SM	A-3, A-2, A-4	0	100	95-100	50-85	5-50	<20	NP-5
52*:											
Hecla----------	0-7	Loamy fine sand	SM, SC-SM, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	7-23	Loamy sand, loamy fine sand, fine sand.	SM, SC-SM, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	23-60	Loamy sand, fine sand, loamy fine sand.	SM, SC-SM, SP-SM	A-2	0	100	95-100	85-100	10-35	<25	NP-7
Ulen----------	0-22	Fine sandy loam	SM, SC-SM, SC	A-4	0	100	100	80-100	35-50	<25	NP-8
	22-60	Fine sand, loamy fine sand, sand.	SP-SM, SM	A-3, A-2	0	100	95-100	80-100	5-35	---	NP
54B*:											
Hecla----------	0-7	Loamy fine sand	SM, SC-SM, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	7-23	Loamy sand, loamy fine sand, fine sand.	SM, SC-SM, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	23-60	Loamy sand, fine sand, loamy fine sand.	SM, SC-SM, SP-SM	A-2	0	100	95-100	85-100	10-35	<25	NP-7
Towner----------	0-7	Loamy fine sand	SM, SC-SM	A-2	0	100	100	50-80	15-35	<25	NP-5
	7-26	Loamy sand, loamy fine sand, fine sand.	SM, SC-SM, SW-SM, SP-SM	A-2, A-3	0	100	95-100	50-100	5-35	<25	NP-5
	26-60	Loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-100	55-100	25-50	5-30
55---------- Towner	0-7	Loamy fine sand	SM, SC-SM	A-2	0	100	100	50-80	15-35	<25	NP-5
	7-26	Loamy sand, loamy fine sand, fine sand.	SM, SC-SM, SW-SM, SP-SM	A-2, A-3	0	100	95-100	50-100	5-35	<25	NP-5
	26-60	Loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-100	55-100	25-50	5-30
56---------- Swenoda	0-11	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	11-29	Fine sandy loam, sandy loam.	SC-SM, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-100	30-60	15-30	NP-10
	29-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	90-100	75-100	50-95	20-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
56B*:											
Swenoda	0-11	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	11-29	Fine sandy loam, sandy loam.	SC-SM, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-100	30-60	15-30	NP-10
	29-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	90-100	75-100	50-95	20-50	5-30
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
56C*:											
Swenoda	0-11	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	11-29	Fine sandy loam, sandy loam.	SC-SM, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-100	30-60	15-30	NP-10
	29-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	90-100	75-100	50-95	20-50	5-30
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
57B	0-18	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	60-95	30-75	<35	NP-10
Embden	18-32	Fine sandy loam, sandy loam.	SM, ML	A-2, A-4	0	100	100	60-100	25-55	---	NP
	32-60	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	100	100	50-100	15-50	---	NP
58B	0-17	Fine sandy loam	SM	A-2, A-4	0	100	95-100	60-85	25-50	<30	NP-7
Clontarf	17-25	Sandy loam, loam, fine sandy loam.	ML, SM	A-2, A-4	0	100	95-100	60-95	20-60	<30	NP-7
	25-60	Sand, fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	85-100	85-100	50-80	5-35	<20	NP
60*:											
Hamerly	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Cresbard	0-9	Loam	ML, CL	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	9-19	Clay loam, silty clay, clay.	CL, CH	A-7, A-6	0	95-100	90-100	90-100	65-85	30-60	15-30
	19-22	Clay loam, silty clay, clay.	CL, CH	A-7	0	95-100	90-100	85-100	55-85	30-60	15-30
	22-60	Clay loam, loam	CL, CH	A-6, A-7	0-5	95-100	90-100	85-100	50-80	25-55	10-27
61B*:											
Swenoda	0-11	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	11-29	Fine sandy loam, sandy loam.	SC-SM, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-100	30-60	15-30	NP-10
	29-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	90-100	75-100	50-95	20-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
61B*:											
Larson	0-8	Fine sandy loam	SC, SC-SM, CL, CL-ML	A-4	0-5	95-100	85-100	75-100	35-55	<25	5-10
	8-21	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	85-100	75-100	60-80	30-45	10-30
	21-60	Loam, clay loam.	CL, CL-ML	A-6, A-4, A-7	0-5	95-100	85-100	75-100	50-90	15-45	5-25
62*:											
Svea	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-22	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	22-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30
Cresbard	0-9	Loam	ML, CL	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	9-19	Clay loam, silty clay, clay.	CL, CH	A-7, A-6	0	95-100	90-100	90-100	65-85	30-60	15-30
	19-22	Clay loam, silty clay, clay.	CL, CH	A-7, A-6	0	95-100	90-100	85-100	65-85	40-60	15-30
	22-60	Clay loam, loam	CL, CH	A-6, A-7, A-4	0-5	95-100	90-100	85-100	50-80	25-55	10-27
62B*:											
Barnes	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	12-29	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	29-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Cresbard	0-9	Loam	ML, CL	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	9-19	Clay loam, silty clay, clay.	CL, CH	A-7, A-6	0	95-100	90-100	90-100	65-85	30-60	15-30
	19-22	Clay loam, silty clay, clay.	CL, CH	A-7, A-6	0	95-100	90-100	85-100	65-85	40-60	15-30
	22-60	Clay loam, loam	CL, CH	A-6, A-7, A-4	0-5	95-100	90-100	85-100	50-80	25-55	10-27
63*:											
Cresbard	0-9	Loam	ML, CL	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	9-19	Clay loam, silty clay, clay.	CL, CH	A-7, A-6	0	95-100	90-100	90-100	65-85	30-60	15-30
	19-22	Clay loam, silty clay, clay.	CL, CH	A-7, A-6	0	95-100	90-100	85-100	65-85	40-60	15-30
	22-60	Clay loam, loam	CL, CH	A-6, A-7, A-4	0-5	95-100	90-100	85-100	50-80	25-55	10-27
Cavour	0-11	Loam, fine sandy loam.	ML, MH	A-4, A-6, A-7	0	100	90-100	85-100	60-85	30-55	5-20
	11-30	Silty clay, clay loam, clay.	CL, CH, MH, ML	A-7, A-6	0	100	90-100	90-100	55-85	35-65	15-30
	30-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	90-100	75-100	50-85	35-65	12-35
64*:											
Cavour	0-11	Loam, fine sandy loam.	ML, MH	A-4, A-6, A-7	0	100	90-100	85-100	60-85	30-55	5-20
	11-30	Silty clay, clay loam, clay.	CL, CH, MH, ML	A-7, A-6	0	100	90-100	90-100	55-85	35-65	15-30
	30-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	90-100	75-100	50-85	35-65	12-35

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
64*:											
Miranda	0-6	Loam	CL-ML, CL, ML	A-4, A-6	0	100	100	85-95	60-85	20-40	3-15
	6-14	Loam, clay loam	CL	A-6, A-7	0-5	95-100	95-100	85-95	50-80	30-50	10-30
	14-60	Loam, clay loam, sandy loam.	CL, ML, SM	A-6, A-7, A-4	0-5	95-100	95-100	60-95	30-80	20-50	NP-30
66	0-1	Silt loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-20
Exline	1-10	Clay, silty clay, clay loam.	MH, CH	A-7	0	100	100	95-100	90-100	60-90	30-50
	10-28	Silty clay loam, silty clay, clay.	CH, MH	A-7	0	100	100	95-100	85-100	50-80	20-45
	28-60	Silty clay, silty clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
70	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
Colvin	7-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	10-30
72	0-8	Loamy sand	SM	A-2	0	90-100	70-100	50-85	15-30	---	NP
Minnewaukan	8-41	Sand, loamy sand, gravelly sand.	SM, SP-SM	A-2, A-3	0	90-100	70-100	50-95	5-35	---	NP
	41-60	Clay loam, loam.	CL	A-6, A-7	0	100	95-100	90-100	80-95	25-50	10-25
73*:											
Overly	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-100	30-45	10-25
	14-32	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
	32-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
Bearden	0-8	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	80-95	25-55	10-30
	8-37	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	90-100	80-95	25-55	10-30
	37-60	Silt loam, loam, silty clay.	CL, CH	A-6, A-7	0	100	100	90-100	80-95	25-60	10-30
73B*:											
Great Bend	0-7	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	7-13	Silt loam, silty clay loam.	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	13-20	Silt loam, silty clay loam.	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	20-55	Silt loam, silty clay loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	5-25
	55-60	Very fine sand to clay.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	5-25
Overly	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-100	30-45	10-25
	14-32	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
	32-60	Silt loam, silty clay.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
74---------- Aberdeen	0-15	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	15-31	Silty clay, clay, silty clay loam.	ML, MH	A-7	0	100	100	95-100	90-100	45-75	15-40
	31-44	Silty clay loam, silt loam.	CL, CH, MH, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-55	7-25
	44-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	5-25
76*:											
Fargo----------	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	11-25
	11-19	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	19-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
Colvin----------	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	7-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	10-30
77---------- Colvin	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	7-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	10-30
79B---------- Sinai	0-6	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-60	15-30
	6-21	Silty clay, clay.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	21-29	Silty clay, silty clay loam.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	29-60	Silty clay, silty clay loam.	CL, CH	A-7	0	95-100	95-100	95-100	80-100	40-65	15-35
88C---------- Seelyeville	0-60	Mucky peat-------	PT	A-8	0	---	---	---	---	---	---
90---------- Lamoure	0-35	Silty clay loam	CL, CH, MH, ML	A-7, A-6	0	100	100	95-100	55-100	40-70	15-35
	35-60	Silty clay loam, silt loam.	CL, CH, MH, ML	A-7, A-6	0	100	100	90-100	60-100	40-70	15-35
92*:											
La Prairie------	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	85-95	70-80	25-40	5-15
	14-45	Silt loam, loam.	CL-ML, CL ML	A-4, A-6, A-7	0	100	100	85-100	50-90	25-50	5-25
	45-60	Silt loam, loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	85-100	70-90	25-50	5-25
Lamoure---------	0-35	Silty clay loam	CL, CH, MH, ML	A-7, A-6	0	100	100	95-100	85-100	40-70	15-35
	35-60	Silty clay loam, silt loam.	CL, CH, MH, ML	A-7, A-6	0	100	100	90-100	60-100	40-70	15-35
93---------- La Prairie	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	85-95	70-80	25-40	5-15
	14-45	Silt loam, loam.	CL-ML, CL ML	A-4, A-6, A-7	0	100	100	85-100	50-90	25-50	5-25
	45-60	Silt loam, loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	85-100	70-95	25-50	5-25

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
94, 94B---------- Darnen	0-18	Loam----------	OL, ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-35	2-10
	18-32	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	95-100	90-100	85-100	60-90	20-45	5-25
	32-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	90-100	90-100	80-95	50-85	20-45	5-25
100*. Pits											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
1----------	0-6	0.2-0.6	0.18-0.23	6.6-8.4	2-8	Moderate	0.37	5	4L
Southam	6-27	0.06-0.2	0.14-0.20	6.6-8.4	2-8	High------	0.28		
	27-60	0.06-0.6	0.13-0.17	7.4-9.0	2-8	High------	0.28		
2----------	0-16	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
Parnell	16-36	0.06-0.2	0.13-0.19	6.1-7.8	<2	High------	0.28		
	36-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		
3----------	0-22	0.6-2.0	0.18-0.23	5.6-7.8	<2	Low-------	0.32	5	6
Tonka	22-52	0.06-0.2	0.14-0.19	5.6-7.8	<2	High------	0.43		
	52-60	0.2-0.6	0.14-0.19	6.6-8.4	<2	Moderate	0.43		
4*:									
Hamerly---------	0-9	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
	9-28	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Parnell---------	0-16	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
	16-36	0.06-0.2	0.13-0.19	6.1-7.8	<2	High------	0.28		
	36-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		
5*:									
Hamerly---------	0-9	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
	9-28	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Tonka-----------	0-22	0.6-2.0	0.18-0.23	5.6-7.8	<2	Low-------	0.32	5	6
	22-52	0.06-0.2	0.14-0.19	5.6-7.8	<2	High------	0.43		
	52-60	0.2-0.6	0.14-0.19	6.6-8.4	<2	Moderate	0.43		
13*:									
Hamerly---------	0-9	0.6-2.0	0.12-0.15	7.4-8.4	4-16	Moderate	0.28	5	4L
	9-28	0.6-2.0	0.10-0.13	7.4-8.4	4-16	Moderate	0.28		
	28-60	0.2-0.6	0.10-0.13	7.4-8.4	4-16	Moderate	0.37		
Vallers---------	0-7	0.2-0.6	0.12-0.15	7.4-8.4	4-16	Moderate	0.28	5	4L
	7-30	0.2-0.6	0.10-0.13	7.4-8.4	4-16	Low-------	0.28		
	30-60	0.2-0.6	0.11-0.13	7.4-8.4	4-16	Low-------	0.28		
Colvin----------	0-7	0.2-0.6	0.13-0.16	7.4-8.4	4-16	Moderate	0.32	5	4L
	7-60	0.2-0.6	0.11-0.15	7.4-8.4	4-16	Moderate	0.32		
15----------	0-9	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
Hamerly	9-28	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
16*:									
Hamerly---------	0-9	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
	9-28	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Wyard-----------	0-25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.28	5	6
	25-60	0.6-2.0	0.14-0.22	7.4-8.4	<2	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
18*:									
Hamerly	0-9	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
	9-28	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
23B*:									
Barnes	0-7	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	12-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
23C*, 23D*:									
Barnes	0-7	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	12-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
23F*:									
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
24*:									
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Barnes	0-7	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	12-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
24B*:									
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
24E*:									
Barnes	0-7	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	12-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
24E*:									
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
25E*:									
Barnes	0-7	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	12-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Parnell	0-16	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
	16-36	0.06-0.2	0.13-0.19	6.1-7.8	<2	High	0.28		
	36-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High	0.28		
30C*:									
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Sioux	0-7	0.6-2.0	0.18-0.20	6.6-8.4	<2	Low	0.28	2	5
	7-10	2.0-6.0	0.10-0.15	7.4-8.4	<2	Low	0.20		
	10-60	>6.0	0.03-0.06	7.4-8.4	<2	Low	0.10		
30E*:									
Sioux	0-7	0.6-2.0	0.18-0.20	6.6-8.4	<2	Low	0.28	2	5
	7-10	2.0-6.0	0.10-0.15	7.4-8.4	<2	Low	0.20		
	10-60	>6.0	0.03-0.06	7.4-8.4	<2	Low	0.10		
Barnes	0-7	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	12-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
39F*:									
Kloten	0-6	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	2	6
	6-10	0.6-2.0	0.05-0.19	6.1-8.4	<2	Moderate	0.10		
	10-60	0.01-0.2	---	---	---	---	---		
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
40*:									
Divide	0-10	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low	0.28	4	4L
	10-22	0.6-2.0	0.16-0.19	7.4-8.4	<2	Low	0.28		
	22-60	6.0-20	0.03-0.07	7.4-8.4	<2	Low	0.10		
Marysland	0-8	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	4	4L
	8-32	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.28		
	32-60	6.0-20	0.02-0.07	7.9-8.4	<2	Low	0.15		
41*, 41B*:									
Fordville	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.24	4	6
	7-27	0.6-2.0	0.18-0.21	6.1-7.8	<2	Moderate	0.24		
	27-32	0.6-2.0	0.12-0.18	6.1-8.4	<2	Low	0.24		
	32-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low	0.10		
Renshaw	0-7	0.6-2.0	0.18-0.20	6.1-7.8	<2	Low	0.28	3	6
	7-15	0.6-2.0	0.11-0.18	6.6-8.4	<2	Low	0.28		
	15-60	6.0-20	0.03-0.06	6.6-8.4	<2	Low	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
44*:									
Arvilla	0-8	2.0-6.0	0.13-0.15	6.6-8.4	<2	Low	0.20	3	3
	8-18	2.0-6.0	0.11-0.14	6.6-8.4	<2	Low	0.20		
	18-60	>20	0.02-0.05	7.4-8.4	<2	Low	0.10		
Sioux	0-7	6.0-20	0.11-0.15	6.6-8.4	<2	Low	0.20	2	3
	7-10	6.0-20	0.10-0.15	6.6-8.4	<2	Low	0.20		
	10-60	>20	0.03-0.06	7.4-8.4	<2	Low	0.10		
44C*, 44E*:									
Sioux	0-7	6.0-20	0.11-0.15	6.6-8.4	<2	Low	0.20	2	3
	7-10	6.0-20	0.10-0.15	6.6-8.4	<2	Low	0.20		
	10-60	>20	0.03-0.06	7.4-8.4	<2	Low	0.10		
Arvilla	0-8	2.0-6.0	0.13-0.15	6.6-8.4	<2	Low	0.20	3	3
	8-18	2.0-6.0	0.11-0.14	6.6-8.4	<2	Low	0.20		
	18-60	>20	0.02-0.05	7.4-8.4	<2	Low	0.10		
47B*:									
Renshaw	0-7	0.6-2.0	0.18-0.20	6.1-7.8	<2	Low	0.28	3	5
	7-15	0.6-2.0	0.11-0.18	6.6-8.4	<2	Low	0.28		
	15-60	6.0-20	0.03-0.06	6.6-8.4	<2	Low	0.10		
Sioux	0-7	6.0-20	0.18-0.20	6.6-8.4	<2	Low	0.28	2	5
	7-10	6.0-20	0.10-0.15	6.6-8.4	<2	Low	0.20		
	10-60	>20	0.03-0.06	7.4-8.4	<2	Low	0.10		
48B, 48D	0-15	6.0-20	0.08-0.12	6.6-7.8	<2	Low	0.17	5	2
Maddock	15-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low	0.17		
49	0-15	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low	0.20	5	3
Wyndmere	15-32	2.0-6.0	0.12-0.17	7.4-8.4	<2	Low	0.20		
	32-51	2.0-6.0	0.06-0.16	7.4-8.4	<2	Low	0.20		
	51-60	0.2-0.6	0.14-0.22	7.4-8.4	<2	Moderate	0.28		
50	0-8	6.0-20	0.13-0.18	7.4-8.4	<2	Low	0.20	5	3
Fossum	8-30	6.0-20	0.06-0.11	7.4-8.4	<2	Low	0.17		
	30-60	6.0-20	0.05-0.09	7.4-8.4	<2	Low	0.17		
51	0-24	2.0-6.0	0.10-0.12	7.4-8.4	4-16	Low	0.24	4	4L
Arveson	24-42	0.6-2.0	0.10-0.11	7.4-8.4	4-16	Low	0.24		
	42-60	2.0-6.0	0.03-0.10	7.4-8.4	4-16	Low	0.17		
52*:									
Hecla	0-7	6.0-20	0.10-0.12	6.1-7.8	<2	Low	0.17	5	2
	7-23	6.0-20	0.10-0.12	6.1-7.8	<2	Low	0.17		
	23-60	6.0-20	0.06-0.10	6.1-8.4	<2	Low	0.17		
Ulen	0-22	6.0-20	0.13-0.18	7.4-8.4	<4	Low	0.17	5	3
	22-60	6.0-20	0.06-0.08	7.4-8.4	<4	Low	0.17		
54B*:									
Hecla	0-7	6.0-20	0.10-0.12	6.1-7.8	<2	Low	0.17	5	2
	7-23	6.0-20	0.10-0.12	6.1-7.8	<2	Low	0.17		
	23-60	6.0-20	0.06-0.10	6.1-8.4	<2	Low	0.17		
Towner	0-7	6.0-20	0.08-0.12	6.6-7.8	<2	Low	0.17	5	2
	7-26	6.0-20	0.06-0.13	6.6-7.8	<2	Low	0.17		
	26-60	0.2-0.6	0.14-0.22	7.4-8.4	<2	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
55	0-7	6.0-20	0.08-0.12	6.6-7.8	<2	Low	0.17	5	2
Towner	7-26	6.0-20	0.06-0.13	6.6-7.8	<2	Low	0.17		
	26-60	0.2-0.6	0.14-0.22	7.4-8.4	<2	Moderate	0.37		
56	0-11	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low	0.20	5	3
Swenoda	11-29	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low	0.20		
	29-60	0.2-0.6	0.17-0.20	7.4-8.4	<4	Moderate	0.37		
56B*:									
Swenoda	0-11	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low	0.20	5	3
	11-29	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low	0.20		
	29-60	0.2-0.6	0.17-0.20	7.4-8.4	<4	Moderate	0.37		
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
56C*:									
Swenoda	0-11	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low	0.20	5	3
	11-29	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low	0.20		
	29-60	0.2-0.6	0.17-0.20	7.4-7.8	<4	Moderate	0.37		
Buse	0-7	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
57B	0-18	2.0-6.0	0.13-0.18	6.6-7.3	<2	Low	0.20	5	3
Embden	18-32	2.0-6.0	0.12-0.17	6.6-7.8	<2	Low	0.20		
	32-60	2.0-6.0	0.06-0.16	6.6-8.4	<2	Low	0.20		
58B	0-17	2.0-6.0	0.13-0.18	6.1-7.3	<2	Low	0.20	4	3
Clontarf	17-25	2.0-6.0	0.12-0.19	6.1-7.8	<2	Low	0.20		
	25-60	6.0-20	0.05-0.09	6.6-7.8	<2	Low	0.15		
60*:									
Hamerly	0-9	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
	9-28	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Cresbard	0-9	0.2-0.6	0.17-0.20	5.6-7.3	<2	Low	0.32	3	6
	9-19	0.06-0.2	0.11-0.14	5.6-7.8	2-4	High	0.32		
	19-22	0.06-0.2	0.11-0.15	6.1-8.4	2-4	High	0.32		
	22-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.32		
61B*:									
Swenoda	0-11	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low	0.20	5	3
	11-29	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low	0.20		
	29-60	0.2-0.6	0.17-0.20	7.4-8.4	<4	Moderate	0.37		
Larson	0-8	0.6-2.0	0.16-0.18	6.1-7.3	<2	Low	0.20	3	3
	8-21	0.06-0.2	0.10-0.14	7.4-9.0	4-16	Moderate	0.32		
	21-60	0.6-2.0	0.12-0.16	7.9-9.0	2-8	Moderate	0.32		
62*:									
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Cresbard	0-9	0.2-0.6	0.17-0.20	5.6-7.3	<2	Low	0.32	3	6
	9-19	0.06-0.2	0.11-0.14	5.6-7.8	2-4	High	0.32		
	19-22	0.06-0.2	0.11-0.15	6.1-8.4	2-4	High	0.32		
	22-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.32		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
62B*:									
Barnes	0-7	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	12-29	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
	29-60	0.2-0.6	0.14-0.19	7.4-8.4	<8	Moderate	0.37		
Cresbard	0-9	0.2-0.6	0.17-0.20	5.6-7.3	<2	Low	0.32	3	6
	9-19	0.06-0.2	0.11-0.14	5.6-7.8	2-4	High	0.32		
	19-22	0.06-0.2	0.11-0.15	6.1-8.4	2-4	High	0.32		
	22-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.32		
63*:									
Cresbard	0-9	0.2-0.6	0.17-0.20	5.6-7.3	<2	Low	0.32	3	6
	9-19	0.06-0.2	0.11-0.14	5.6-7.8	2-4	High	0.32		
	19-22	0.06-0.2	0.11-0.15	6.1-8.4	2-4	High	0.32		
	22-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.32		
Cavour	0-11	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	11-30	0.06-0.2	0.10-0.16	6.6-9.0	4-16	High	0.37		
	30-60	0.06-0.2	0.11-0.15	7.4-9.0	8-16	Moderate	0.37		
64*:									
Cavour	0-11	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	11-30	0.06-0.2	0.10-0.16	6.6-9.0	4-16	High	0.37		
	30-60	0.06-0.2	0.11-0.15	7.4-9.0	8-16	Moderate	0.37		
Miranda	0-6	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.32	3	6
	6-14	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate	0.32		
	14-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate	0.32		
66	0-1	0.6-2.0	0.19-0.22	6.1-7.8	<2	Low	0.37	3	6
Exline	1-10	<0.06	0.10-0.15	6.6-9.0	4-16	High	0.28		
	10-28	0.06-0.2	0.14-0.17	7.9-9.0	4-8	High	0.43		
	28-60	0.06-0.2	0.14-0.17	7.4-9.0	2-8	Moderate	0.43		
70	0-7	0.2-0.6	0.20-0.22	7.4-8.4	<2	Moderate	0.32	5	4L
Colvin	7-60	0.2-0.6	0.16-0.20	7.4-8.4	<2	Moderate	0.32		
72	0-8	6.0-20	0.05-0.10	6.6-8.4	2-4	Low	0.17	5	2
Minnewaukan	8-41	6.0-20	0.05-0.10	7.4-8.4	2-4	Low	0.15		
	41-60	0.2-0.6	0.14-0.19	7.4-8.4	2-4	Moderate	0.24		
73*:									
Overly	0-14	0.2-0.6	0.17-0.23	6.6-7.8	<2	Moderate	0.32	5	7
	14-32	0.2-0.6	0.17-0.22	6.6-8.4	<2	Moderate	0.32		
	32-60	0.2-0.6	0.13-0.22	7.9-8.4	<2	Moderate	0.32		
Bearden	0-8	0.2-0.6	0.17-0.23	7.4-8.4	<4	Moderate	0.28	5	4L
	8-37	0.2-0.6	0.16-0.22	7.4-8.4	<4	Moderate	0.28		
	37-60	0.2-0.6	0.16-0.22	7.4-8.4	<8	Moderate	0.43		
73B*:									
Great Bend	0-7	0.6-2.0	0.19-0.22	6.1-7.8	<2	Moderate	0.32	5	7
	7-13	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43		
	13-20	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low	0.43		
	20-55	0.2-0.6	0.17-0.20	7.4-8.4	<4	Low	0.43		
	55-60	0.2-0.6	0.17-0.20	7.4-8.4	<8	Low	0.43		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
73B*:									
Overly	0-14	0.2-0.6	0.17-0.23	6.6-7.8	<2	Moderate	0.32	5	7
	14-32	0.2-0.6	0.17-0.22	6.6-8.4	<2	Moderate	0.32		
	32-60	0.2-0.6	0.13-0.22	7.9-8.4	<2	Moderate	0.32		
74	0-15	0.2-0.6	0.19-0.22	5.6-7.3	<2	Moderate	0.32	3	7
Aberdeen	15-31	0.06-0.2	0.13-0.18	6.6-8.4	<4	High	0.32		
	31-44	0.06-0.6	0.14-0.17	7.4-9.0	2-8	High	0.43		
	44-60	0.06-0.6	0.14-0.17	7.4-9.0	2-8	Low	0.43		
76*:									
Fargo	0-11	0.06-0.2	0.18-0.23	6.6-7.8	<2	Moderate	0.32	5	7
	11-19	0.06-0.2	0.14-0.17	6.6-8.4	<2	High	0.32		
	19-60	0.06-0.2	0.14-0.17	7.9-8.4	<2	High	0.32		
Colvin	0-7	0.2-0.6	0.20-0.22	7.4-8.4	<2	Moderate	0.32	5	4L
	7-60	0.2-0.6	0.16-0.20	7.4-8.4	<2	Moderate	0.32		
77	0-7	0.2-0.6	0.20-0.22	7.4-8.4	<2	Moderate	0.32	5	4L
Colvin	7-60	0.2-0.6	0.16-0.20	7.4-8.4	<2	Moderate	0.32		
79B	0-6	0.06-0.2	0.17-0.19	6.1-7.3	<2	High	0.28	5	7
Sinai	6-21	0.06-0.2	0.17-0.19	6.6-7.8	<2	High	0.28		
	21-29	0.06-0.2	0.11-0.17	7.4-8.4	<2	High	0.28		
	29-60	0.06-0.2	0.11-0.17	7.4-8.4	<2	High	0.43		
88C	0-60	0.6-2.0	0.35-0.45	6.1-7.8	<2		0.10	5	8
Seelyeville									
90	0-35	0.2-0.6	0.19-0.22	7.4-8.4	<4	Moderate	0.28	5	4L
Lamoure	35-60	0.2-0.6	0.17-0.20	7.4-8.4	<4	Moderate	0.28		
92*:									
La Prairie	0-14	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low	0.28	5	6
	14-45	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28		
	45-60	0.6-2.0	0.15-0.22	6.6-8.4	<2	Moderate	0.28		
Lamoure	0-35	0.2-0.6	0.19-0.22	7.4-8.4	<4	Moderate	0.28	5	4L
	35-60	0.2-0.6	0.17-0.20	7.4-8.4	<4	Moderate	0.28		
93	0-14	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low	0.28	5	6
La Prairie	14-45	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28		
	45-60	0.6-2.0	0.15-0.22	6.6-8.4	<2	Moderate	0.28		
94, 94B	0-18	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
Darnen	18-32	0.6-2.0	0.15-0.19	6.1-7.8	<2	Moderate	0.28		
	32-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
100*									
Pits									

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1---------- Southam	D	None	---	---	+5-1.0	Apparent	Jan-Dec	>60	---	High	High	Low.
2---------- Parnell	C/D	None	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	High	High	Low.
3---------- Tonka	C/D	None	---	---	+.5-1.0	Apparent	Apr-Jun	>60	---	High	High	Low.
4*:												
Hamerly----------	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High	High	Low.
Parnell----------	C/D	None	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	High	High	Low.
5*:												
Hamerly----------	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High	High	Low.
Tonka----------	C/D	None	---	---	+.5-1.0	Apparent	Apr-Jun	>60	---	High	High	Low.
13*:												
Hamerly----------	C	None	---	---	2.0-4.0	Apparent	Sep-Jun	>60	---	High	High	Moderate.
Vallers----------	C	Rare	---	---	0-1.0	Apparent	Apr-Jul	>60	---	High	High	Moderate.
Colvin----------	C/D	Rare	---	---	0-2.0	Apparent	Apr-Jul	>60	---	High	High	Moderate.
15---------- Hamerly	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High	High	Low.
16*:												
Hamerly----------	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High	High	Low.
Wyard----------	B	None	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High	High	Low.
18*:												
Hamerly----------	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High	High	Low.
Svea----------	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Low.
23B*:												
Barnes----------	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Svea----------	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
23C*, 23D*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
23F*:												
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Svea	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
24*:												
Svea	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Low.
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
24B*:												
Svea	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Low.
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
24E*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Svea	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
25E*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Parnell	C/D	None	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	High	High	Low.
30C*:												
Svea	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Sioux	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
30E*:												
Sioux	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
39F*:												
Kloten	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
40*:												
Divide	B	None	---	---	2.5-5.0	Apparent	Apr-Jun	>60	---	Moderate	High	Low.
Marysland	B/D	None	---	---	0-2.0	Apparent	Nov-Jul	>60	---	High	High	Low.
41*, 41B*:												
Fordville	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Renshaw	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
44*:												
Arvilla	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Sioux	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
44C*, 44E*:												
Sioux	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Arvilla	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
47B*:												
Renshaw	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Sioux	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
48B, 48D Maddock	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
49 Wyndmere	B	None	---	---	2.0-5.0	Apparent	Sep-Jun	>60	---	High	High	Low.
50 Fossum	A/D	None	---	---	1.0-2.5	Apparent	Nov-Oct	>60	---	Moderate	High	Low.
51 Arveson	B/D	None	---	---	0-2.0	Apparent	Apr-Jul	>60	---	High	High	Low.
52*:												
Hecla	A	None	---	---	3.0-6.0	Apparent	Apr-Oct	>60	---	Moderate	Moderate	Low.
Ulen	B	None	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	Moderate	Low	Low.
54B*:												
Hecla	A	None	---	---	3.0-6.0	Apparent	Apr-Oct	>60	---	Moderate	Moderate	Low.
Towner	B	None	---	---	3.0-6.0	Perched	Apr-Jun	>60	---	Moderate	High	Low.
55 Towner	B	None	---	---	3.0-6.0	Perched	Apr-Jun	>60	---	Moderate	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
56---------- Swenoda	B	None---------	---	---	2.5-4.0	Perched	Mar-Jun	>60	---	Moderate	High-----	Moderate.
56B*: Swenoda----------	B	None---------	---	---	2.5-4.0	Perched	Mar-Jun	>60	---	Moderate	High-----	Moderate.
Buse----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
56C*: Swenoda----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
Buse----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
57B---------- Embden	B	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Low.
58B---------- Clontarf	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
60*: Hamerly----------	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
Cresbard---------	C	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Moderate.
61B*: Swenoda----------	B	None---------	---	---	2.5-4.0	Perched	Mar-Jun	>60	---	Moderate	High-----	Moderate.
Larson----------	D	None---------	---	---	3.0-6.0	Apparent	Mar-Jun	>60	---	Moderate	High-----	Moderate.
62*: Svea----------	B	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Low.
Cresbard---------	C	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Moderate.
62B*: Barnes----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Cresbard---------	C	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Moderate.
63*: Cresbard---------	C	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Moderate.
Cavour----------	D	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Moderate.
64*: Cavour----------	D	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Moderate.
Miranda----------	D	None---------	---	---	2.0-4.0	Apparent	Apr-Jul	>60	---	Moderate	High-----	Moderate.
66---------- Exline	D	None---------	---	---	2.5-4.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	High.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
70---------- Colvin	C/D	None--------	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Low.
72---------- Minnewaukan	A/D	Occasional	Long------	Apr-Jun	0-2.0	Apparent	Mar-Jul	>60	---	Moderate	High-----	Low.
73*:												
Overly----------	C	None--------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
Bearden----------	C	None--------	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
73B*:												
Great Bend-------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	High-----	Moderate.
Overly----------	C	None--------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
74---------- Aberdeen	C	None--------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Moderate.
76*:												
Fargo----------	D	None--------	---	---	0-3.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
Colvin----------	C/D	None--------	---	---	0-1.0	Apparent	Apr-Jul	>60	---	High-----	High-----	Low.
77---------- Colvin	C/D	None--------	---	---	0-1.0	Apparent	Apr-Jul	>60	---	High-----	High-----	Low.
79B---------- Sinai	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	High.
88C---------- Seelyeville	D	None--------	---	---	0-2.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Moderate.
90---------- Lamoure	C	Occasional	Brief-----	Mar-Oct	0-2.0	Apparent	Oct-Jun	>60	---	High-----	High-----	Moderate.
92*:												
La Prairie-------	B	Occasional	Brief-----	Mar-Jun	3.5-6.0	Apparent	Mar-Jun	>60	---	Moderate	Moderate	Low.
Lamoure----------	C	Occasional	Brief-----	Mar-Oct	0-2.0	Apparent	Oct-Jun	>60	---	High-----	High-----	Moderate.
93---------- La Prairie	B	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
94, 94B---------- Darnen	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
100*. Pits												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. LL means liquid limit; PI, plasticity index; MD, maximum dry density; OM, optimum moisture; and NP, nonplastic. All data except the Unified classification supplied by the North Dakota State Highway Department)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution: Percentage passing sieve-- 3/8 inch	No. 4	No. 10	No. 40	No. 200	Percentage smaller than .005 mm	LL	PI	Moisture density: MD	OM
	AASHTO	Unified							Pct		Lb/ cu ft	Pct
Arvilla silt loam: (S84ND093-19)												
Bw----- 6 to 14	A-2-4(0)	SM	98	94	87	66	26	3	37	8	125	11
2C----- 18 to 60	A-2-4(0)	SM	93	85	75	51	14	3	---	NP	129	9
Cavour loam: (S86ND093-78)												
Btn---- 12 to 19	A-6(13)	CL	100	100	100	94	75	40	38	19	115	14
C------ 44 to 60	A-7-6(16)	CL	100	99	96	91	73	41	40	24	121	12
Cresbard loam: (S86ND093-74)												
Btn---- 19 to 29	A-7-6(20)	CL	100	100	100	95	77	38	45	27	115	14
C------ 45 to 60	A-6(14)	CL	98	97	97	91	70	36	40	22	118	13
Cresbard loam: (S85ND093-42)												
Btn---- 19 to 22	A-6(5)	CL	99	98	95	85	55	24	31	15	123	11
C------ 28 to 60	A-4(3)	CL	98	96	93	82	54	21	29	10	122	12
Darnen loam: (S84ND093-1)												
Bw----- 18 to 28	A-6(8)	CL	100	99	99	94	68	29	34	15	119	13
2C----- 32 to 60	A-4(1)	CL	99	98	94	87	52	18	26	8	123	11
Darnen loam: (S86ND093-70)												
Bw----- 12 to 24	A-6(9)	CL	100	100	100	98	70	23	34	16	113	15
C------ 34 to 60	A-6(7)	CL	100	100	100	95	64	25	30	15	123	11
La Prairie silt loam: (S85ND093-55)												
Bw----- 14 to 24	A-7-6(21)	ML	100	100	100	99	87	25	49	21	97	21
C------ 35 to 52	A-7-6(19)	CL	100	100	100	100	88	31	44	20	106	17
Lamoure silty clay loam: (S86ND093-71)												
C------ 22 to 28	A-6(9)	CL	100	100	100	95	59	19	40	19	110	16
Ab----- 34 to 58	A-6(9)	CL	100	100	100	98	60	27	36	19	116	14
Lamoure silty clay loam: (S85ND093-52)												
A------ 9 to 24	A-7-5(26)	MH	100	100	100	99	91	41	55	24	100	20
C------ 35 to 51	A-6(6)	CL	100	100	100	100	60	22	33	14	112	15

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution						LL	PI	Moisture density	
			Percentage passing sieve--					Percentage smaller				
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	than .005 mm			MD	OM
									Pct		Lb/ cu ft	Pct
Sinai silty clay loam: (S86ND098-35)												
Bw----- 12 to 22	A-7-6(26)	CL	100	100	100	99	93	49	48	25	109	16
C------ 42 to 60	A-7-6(28)	CL	100	100	100	99	96	48	49	26	108	17
Swenoda fine sandy loam: (S85ND093-35)												
Bw----- 19 to 29	A-4(1)	CL-ML	100	100	100	99	56	16	26	5	124	11
2C----- 43 to 60	A-4(1)	CL-Ml	97	94	90	81	55	19	24	7	124	11
Towner loamy fine sand: (S85ND093-36)												
Bw----- 20 to 26	A-2-4(0)	SM	100	100	100	95	19	8	---	NP	127	10
2C----- 41 to 60	A-6(4)	CL	98	96	92	85	58	25	27	12	129	9
Towner loamy fine sand: (S85ND093-40)												
Bw----- 14 to 26	A-2-4(0)	SM	100	100	100	93	19	6	---	NP	127	10
2C----- 46 to 60	A-6(8)	CL	100	99	98	92	66	31	32	16	127	10

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Aberdeen	Fine, montmorillonitic Glossic Udic Natriborolls
Arveson	Coarse-loamy, frigid Typic Calciaquolls
*Arvilla	Sandy, mixed Udic Haploborolls
Barnes	Fine-loamy, mixed Udic Haploborolls
Bearden	Fine-silty, frigid Aeric Calciaquolls
Buse	Fine-loamy, mixed Udorthentic Haploborolls
Cavour	Fine, montmorillonitic Udic Natriborolls
Clontarf	Coarse-loamy, mixed Pachic Udic Haploborolls
Colvin	Fine-silty, frigid Typic Calciaquolls
Cresbard	Fine, montmorillonitic Glossic Udic Natriborolls
Darnen	Fine-loamy, mixed Pachic Udic Haploborolls
Divide	Fine-loamy over sandy or sandy-skeletal, frigid Aeric Calciaquolls
Embden	Coarse-loamy, mixed Pachic Udic Haploborolls
Exline	Fine, montmorillonitic Leptic Natriborolls
Fargo	Fine, montmorillonitic, frigid Vertic Haplaquolls
Fordville	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Fossum	Sandy, mixed (calcareous), frigid Typic Haplaquolls
Great Bend	Fine-silty, mixed Udic Haploborolls
Hamerly	Fine-loamy, frigid Aeric Calciaquolls
Hecla	Sandy, mixed Aquic Haploborolls
Kloten	Loamy, mixed, shallow Udorthentic Haploborolls
La Prairie	Fine-loamy, mixed Cumulic Udic Haploborolls
Lamoure	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Larson	Fine-loamy, mixed Udic Natriborolls
*Maddock	Sandy, mixed Udorthentic Haploborolls
Marysland	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
Minnewaukan	Mixed, frigid Typic Psammaquents
Miranda	Fine-loamy, mixed Leptic Natriborolls
Overly	Fine-silty, mixed Pachic Udic Haploborolls
Parnell	Fine, montmorillonitic, frigid Typic Argiaquolls
Renshaw	Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls
Seelyeville	Euic Typic Borosaprists
Sinai	Fine, montmorillonitic Udertic Haploborolls
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Southam	Fine, montmorillonitic (calcareous), frigid Cumulic Haplaquolls
Svea	Fine-loamy, mixed Pachic Udic Haploborolls
Swenoda	Coarse-loamy, mixed Pachic Udic Haploborolls
Tonka	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Towner	Sandy over loamy, mixed Udorthentic Haploborolls
Ulen	Sandy, frigid Aeric Calciaquolls
Vallers	Fine-loamy, frigid Typic Calciaquolls
Wyard	Fine-loamy, mixed, frigid Typic Haplaquolls
Wyndmere	Coarse-loamy, frigid Aeric Calciaquolls

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